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Vol. VII. NEW YORK, JUNE 5, 1886. No. 23.

ONE of our medical friends describes in this issue a remedy for "electric light shocks." Remedies made up of the ingredients he mentions are likely to be called for very frequently, regardless of the number or severity of the shocks. However, the information is well worth having, and should be posted up in electric light stations.

IT looks as though the question of wire gauge is still an open one in this country. The telephone and the electric light associations have given the new British standard gauge their indorsement, which has been seconded by the American Institute of Electrical Engineers, but it is said that in practice the gauge is by no means generally or uniformly used.

THE statement that a galvanic battery can supply energy to an electric motor and a *steam engine* at the same time might at the first blush appear to be an effort of the imagination, but the ingenious experiment described in another column shows in what way the feat can be accomplished. It demonstrates the principle of the conservation and convertibility of energy in four ways, viz., chemical, electrical, mechanical and radiant energy in the form of heat. It might be difficult to devise a single experiment of greater beauty and comprehensiveness than this.

THE suit against the Western Union Company for $2,000,000, as the amount of damage inflicted on the Bankers & Merchants' Company, continues to attract an unusual amount of public interest, and is being fought with great ability by both sides. But the defendant corporation must have a weak case, one would think, when it has to object to the evidence of Mr. D. H. Bates, and that of Mr. Francis W. Jones, on the ground that neither gentleman is an expert! The objection thus raised seriously by Mr. Choate is too absurd to be funny—and so thought the Court.

ANOTHER decision in favor of Prof. Bell has just been given in the New Orleans suit, the court making up its mind that the claims urged on behalf of Reis or others were not established or of importance. In fact, the whole interest of the telephone controversy is centring now around the case of Prof. Elisha Gray, although the Government is meantime collecting evidence abroad to be used in its suit to annul the Bell patent. We print in this issue Gray's specification filed in 1876 as a caveat, a most remarkable document, of which Prof. Gray himself said in 1878, while not raising the question of priority of invention: "So far as I am aware, this is the first description on record of an articulating telephone which transmits the spoken words of the human voice telegraphically by means of electricity."

THE American Institute of Electrical Engineers will hold its first monthly meeting on the 8th inst. at the D'Orville restaurant, Mills Building, Broad street. The supper will be served at 6 P. M., and the meeting will be called to order about 7:30, when one of the subjects presented for discussion will be "Incandescent Lighting from Central Stations," in connection with which it is expected that Mr. H. M. Byllesby will bring some important points under review. A large attendance is looked for, and there is every reason to believe that this combination of social and intellectual pleasure with practical instruction will be eminently successful. The same plan is pursued by electricians in England and France with very happy results, and has already been hailed here with the greatest favor by all interested.

AFTER the extended period of use which incandescent lamps have now enjoyed, the question as to utility of the vacuum is once more brought forward by the Siemenses, who maintain that an atmosphere of hydrogen surrounding the filament not only prevents the deposit of carbon on the sides of the globe, but also increases the efficiency of the lamp by the increased potential at which it permits the lamp to be run. It has often been pointed out that many of the failures of incandescent lamps are due to the defective vacuum. But, on the other hand, theory would seem to point to the fact that the higher the vacuum in the globe, and consequently the greater the mean free path of each molecule remaining, the freer would be the action of the particles of carbon thrown off, which blacken the globe. Hence the filling of the globe with an inert gas offers one way to remove both the difficulty in obtaining a good vacuum and the evil of the blackened globes.

WHATEVER M. Planté has to say regarding the subject of storage-batteries deserves attention, not only because of the long experience which he has had, but also on account of his well-known integrity and disinterestedness. Considering the progress made with the modern storage battery, in which the active material is mechanically applied to the electrode, it is peculiarly worthy of note that M. Planté still clings to his original method, the plain lead plates prepared by "forming." It is true that, when carefully handled, good results have been attained with the Planté method, and it is, perhaps, the lack of care and the want of attention to small details that have led to many failures in the past. With a well made Planté battery Mr. Preece has been able to maintain the lighting of his house for two years, which goes to show what can be done with this form of cell when well built and well maintained. The success of the more improved modern storage battery is beyond question, as Mr. Bauer testifies to in his paper, given in another column. Indeed, the position of both forms of battery is alike in that they only require intelligent handling to prove successful.

THE great interest in meteorological observation and weather prediction which has been fostered by the Signal Service Bureau is well illustrated by the proposed action of the New England Meteorological Society. The latter, aided by numerous volunteers, to the number of 300, has determined to make a close study of thunder-storms during the three months beginning June 1. A special feature of the work is found in the appointment, in advance, of certain days, to be called term days, on which thunder-storms may be expected in some parts of New England, and on which all observers are to make certain systematic records. These term days will be appointed by the Signal Office in Washington, and the announcement of them will be sent by telegraph to all newspapers in New England belonging to the Associated Press or the United Press. An extended publication will thus be secured, and the appointments will be brought to the notice of all observers. Such systematic study by numerous observers, widely scattered, cannot fail to establish results of the greatest value. The science of meteorology, and weather prediction especially, has been greatly developed in this country, and the benefits derived therefrom are becoming more manifest as time passes.

THE causes that govern the origin of the fearful Western cyclones, the increasing frequency of which has become alarming, have long been the subject of study and conjecture, but no adequate explanation has yet been vouchsafed by those best able to express an opinion thereon. But if we are to believe an inspired authority, the cause is not difficult to discern and must be looked for in the spread of electric lighting. So says Bishop Turner, of the African Methodist Church of Georgia, Kentucky and Tennessee. While admiring the invention of the white man in controlling electricity, he claims that the subjection of God's agent is carried too far in making it light the world. He predicts that the unbalancing of the air currents which electric lights are causing will in a few years, if they increase in numbers as fast as in the past five years, cause whole cities to be blown away at a time, and floods unlike any save Noah's. All the floods, hurricanes, cyclones and other atmospheric disturbances taking place in the heavens and upon earth are due to the work of electric lighting companies, says the reverend bishop. From this it should appear that electric lighting "must go." But it is possible that the Bishop of the African Methodist Church of Georgia, Kentucky and Tennessee is under a contract with the gas interests of his diocese or holds gas stock.

WHILE the defects of steam as the working medium in an engine are well known, the attempts which have thus far been made to substitute other vapors in its stead can be characterized as uniformly unsuccessful. Indeed, so firmly has the idea become fixed in the minds of engineers that no other vapor than that of water could be successfully applied, that every renewed attempt has been looked upon with distrust; and perhaps fairly so, judging from the past. But in this issue we describe an engine in which bisulphide of carbon is employed instead of steam, and the results of tests would appear to demonstrate that a decided advance has been made over the older forms of vapor engines. While the cycle of operations is not in itself new in the engine, the enhanced efficiency obtained is probably due principally to the jacketing of the cylinder and the surrounding of the expanding bisulphide vapor with a jacket of steam at a considerably higher temperature. By this method cylinder condensation, the great evil in steam engines, is probably almost entirely prevented. This, added to the other devices for utilizing all the available heat may account for the small fuel consumption shown. The subject is one of prime importance to the electrical engineer, whose chief item of cost in obtaining large currents is coal consumption, and this alone is sufficient to account for the deep interest felt by electricians in what has become known as the "Triple Thermic Motor," now illustrated and described for the first time.

ONE of the most interesting features of the history of the storage battery is that exhibited in the work of Charles Kirchhof, who, more than twenty-five years ago, had devised an apparatus of which the modern storage battery is only a few steps in advance. A perusal of the salient points in the patent issued to him in 1861, which we give on another page, shows that he possessed an intimate knowledge of the action involved, and he indicates methods which have been frequently reinvented since then. He draws attention, among other things, to the desirability of roughening the plates and perforating them so as to gain increased surface for action, and he recognized the great value of lead and its peroxide as the active materials, on account of their difference in the scale of electric potentials. While Kirchhof describes his battery as one in which platinum plates are used, although he suggests lead plates, the platinum is only employed as a base upon which the peroxide of lead and lead are respectively deposited. In other words, it is the modern storage battery in which the active materials are deposited out of a lead solution, instead of being derived by the action of the current on a lead salt mechanically applied to the electrodes. This patent, though little known, is one that is frequently referred to by the Patent Office examiners, and certainly deserves recognition. While Kirchhof alludes to the work of a number of others, he makes no mention of Gaston Planté, and the presumption is but fair that he had not heard of it, the more so as it preceded his own (if at all) only a short time. Indeed, the frankness with which he cites the work of others is a guarantee that he had no knowledge of Planté's classical labors. It may be of interest to recall the fact that Kirchhof died only a few years ago in prosperous circumstances due to other inventions of which he was the author. During the active period of Morse's life he was one of his principal assistants, and many ideas of Morse were put into practical shape by this early inventor of a storage battery.

Electrical Matters in England.

A well-informed correspondent writes us as follows:

On Wednesday evening last (12th May), the annual soirée of the Royal Society was held in the noble rooms of Burlington House, London. The visitors, who were more than usually numerous, about 700, were received by the President, Professor Stokes, of Cambridge, attended by the Treasurer, Mr. John Evans, and the Honorary Secretaries, Lord Rayleigh, Dr. Michael Foster, and Professor Williamson. At this soirée the latest scientific novelties are generally produced for the first time, and much speculation is often evoked as to what branch of science will produce the greatest novelty. It would be difficult to number the many scientific inventions which have here first been exposed to the public gaze. The dynamo in action was first shown to the public at one of these soirées, Crooke's radiometer and many other novelties might be mentioned, and the present meeting was no exception. Not for many years has there been so large a display of scientific novelties presented. The principal attention appeared to have been devoted to photography and the results obtained from celestial photography, etc. In electrical matters there were shown some interesting new electrical apparatus by the Electrical Power Storage Company, and a remarkable electrical influence machine by Mr. Wimshurst, having eight discs working within a glass case, and giving off powerful sparks by a slow turning of the handle of the machine under the exercise of very little force. The current appeared to be small in quantity, but possessed of extraordinary intensity. The portable electric lamps, shown by Mr. Pitkin, as suitable for coal mines and powder magazines, certainly exhibit this application of electricity for these and similar purposes more favorably than any previous efforts.

A new fire-damp indicator for coal mines of Mr. E. H. Livering is founded on the principle that when a heated platinum wire or platinum in a finely divided or porous condition is in contact with a mixture of marsh gas and oxygen or air, the marsh gas is wholly or partially consumed, and the heat generated by the combustion is to a certain extent communicated to the platinum, which consequently attains a higher temperature than it would do if surrounded by air. Mr. Livering's indicator is constructed as follows: In a narrow box about 8 in. long are fixed two spirals of a fine platinum wire 4 in. apart; these are arranged to have equal electrical resistances, so that when the same electric current passes through the spirals they are raised to the same temperature. One of these spirals is inclosed in a tube with a glass cover at the end facing the second spiral; this tube is air-tight and is filled with pure air. The second spiral is surrounded by a cylinder of wire gauze, also having a glass cover at the end facing the first spiral. Directly between the glass covers is a small wedge-shaped screen, placed so that one of the inclined surfaces is illuminated only by light from the first spiral, while the other is exposed only to light proceeding from the second spiral. This screen can be observed through a narrow glass window in the top of the box, and it can be moved until the two inclined faces are seen to be equally illuminated. The junction lines of the two inclined screens traverse a graduated scale, and its position relative to the spirals can be then determined. The box is provided with two tubes, to one of which, if necessary, an India rubber tube can be fixed with its open end at any place; for instance, a hollow in the roof, the atmosphere of which it is desired to test. A sample of this atmosphere is readily drawn into the box by aspirating through the other tube. In the base of the box is a small magneto machine, and by turning a handle outside the box an electric current can be passed through both the platinum spirals of sufficient intensity to raise them in air to a moderate red heat.

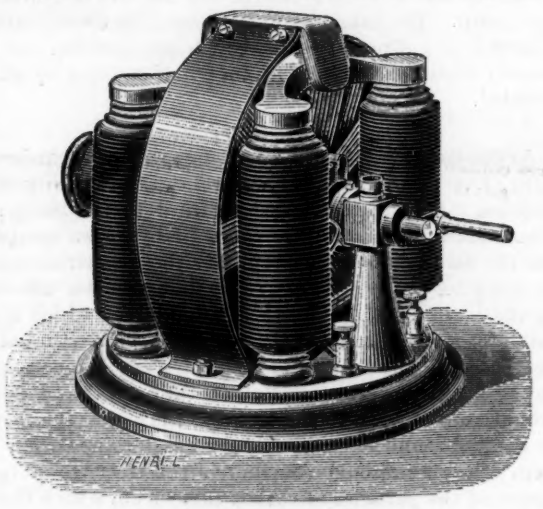
When the atmosphere is free from marsh gas both spirals glow equally, and the screen must be midway between them; but when the gas is present, even to the extent of ‡ per cent. of the volume, the brilliancy of the spiral exposed to the vitiated atmosphere becomes greater than that of the spiral in pure air, and in order to restore the equality of the illumination in the two faces of the screen, this must be moved nearer to the spiral in pure air. The scale may be so graduated by experiment that the percentage of marsh gas contained in the air in the box may be at once read off.

Very satisfactory results were obtained by the use of this instrument, in some experiments lately carried on by the Royal Commission on the prevention of accidents in mines. The commissioners, as was previously remarked, referring to the use of electric lamps in mines, pointed out that they gave no indication of the presence of gas, and that that was a very strong and insurmountable objection to their use in fiery mines, and it is understood that Mr. Swan is about to combine an arrangement of Mr. Livering's indicator with his incandescent miner's lamp.

The question of placing telephone wires underground has naturally brought very strongly to the fore methods for avoiding the great inductive effects which act prejudicially to the telephone, and cables with lead-foil covering and earth wires in connection, such as described in your issue of April 26, are likely to come into use; but the form there described is similar to some anti-induction cables that have been seen here some time since. The only anti-induction cable of any length that has been in use here in the form of a covered cable and placed underground is that through the Mersey Tunnel, between Liverpool and Birkenhead, a total length of about 1¼ miles. As this cable answers very well, a description of it may prove interesting. It was manufactured by Messrs. Felten & Guilleaume for the Lancashire and Cheshire Telephone Company, and consists of 27 wires in all, inclosed in a double lead tube. Each wire is a No. 18 B. W. G., covered with two lappings of cotton, and insulated with a special chemical material, which gives good results. The thickness of each insulated wire is .12 inch; the insulated wire is enveloped by a lapping of narrow strips of thin lead foil, .217 inch wide × .0025 thick. These 27 wires are laid up in the following manner: three together, with three bare copper wires (passed through the insulating material) laid up with a long lay to form the centre. Around these, and laid in the same direction, are 9 similar wires, and outside these are 15 wires also laid in the same direction, so that the 27 wires are each and all completely surrounded with the lead foil, and all are laid spirally in the same direction. These cabled wires or completed core are covered with strips, ¾ in. wide, of cotton cloth, soaked in the insulating compound, and over this is drawn first one lead tube, then a second, the outside tube being slightly thicker than the inner, the thickness of the two being .095 in. The diameter of the cable with its double sheathing of lead is exactly one inch, so the space occupied is but small. The leaden tubes are protected with a wrapping, 1⅜ in. wide, of jute sacking soaked in a pitchy compound laid around it spirally. The cable is laid in wooden troughing. The insulation is stated to be thoroughly good, and no inconvenience is felt in telephoning, as the induction is overcome, the only effect noticed being that there is a slight deadening of the voice. Cables of a precisely similar manufacture have also been used for telephonic purposes in several of the European states.

A Compact Electro-Motor.

The small motor illustrated in the accompanying engraving and known in England as the Lee-Chaster, occupies a space of 8 in. by 8 in., and is said to be capable of



THE LEE-CHASTER MOTOR.

developing energy equal to nearly ¼ h. p., and can be started, stopped or reversed by the simple movement of a switch. It is driven by a battery which is said to involve the minimum of trouble, which will run for about twenty hours without recharging, and can then be restarted with fresh solution in a very short time. The cells are charged with Lee's new double bichromate, soluble in its own weight of cold water, and which does not deposit crystals in the pores of the carbons or in the cells. Molded corrugated carbons are used, and the zincs are so cut as to economize the metal. The cells rest on a tray in a box, and the tray can be raised by means of a treadle until the elements are fully immersed in the solution. Both zincs and carbons are suspended from a board, which forms a lid, so to speak, and the connections are made by means of brass plates, thus avoiding the use of wires. Two wing nuts hold this board to the mechanism of levers, and by removing them, the whole battery of elements can be lifted out, leaving the cells exposed. The zincs and carbons are automatically removed from the solutions when the treadle is released, and the amount of immersion can be regulated to a nicety. It is stated that preparations are being made for fitting a Lee-Chaster motor to a launch.

The Boston Telephone Exchange.*

Of the thousands of people who use the telephone daily in their business and for other purposes in Boston and vicinity, how few know of the extent, the wonderful detail and the complication of appliances which enable them to so readily hold instant communication one with the other. The main or central offices of the Boston exchange district are located in the building corner of Pearl and Franklin streets, and numbered 50 Pearl, and were occupied on Feb. 22, 1885, the move from the former headquarters having been simply made from the building on the opposite corner of Pearl and Franklin streets. Before entering into details of the plant and appliances of the central station, it may be well to state that the Boston exchange district embraces, as defined by its license from the American Bell Telephone Company, a territory of about 15 miles radius from the central office. It has some twenty branch offices, located from one to twelve miles distant from the central office, and the territory thus covered embraces a population of over 589,000. Direct communication is had between the central office and all its branches, and trunk lines proportionate to the numbers of subscribers of the branch offices are employed. In the larger branch offices the double track system is used. In other words, a proportion of the wires employed are used to call subscribers of those offices, while the others are used for return calls. In some cases as many as twenty-six wires are used to connect a single branch office with the central office. This would make a trunk line for each twelve subscribers in the branch offices. The branch offices are also connected with each other by direct wires, as well as through the central office. The system employs in its business 4,565 miles of wires, 3,041 miles of which are strung on posts, 1,171 on buildings, 300 miles are laid under ground and 60 submarine. The wires of the company are embraced principally in cables, there being from 25 to 100 conductors in each cable. These cables are composed of small copper wires thoroughly insulated, the whole being covered with lead pipe, which is then filled with melted paraffine to insure insulation. These cables are then suspended on strong steel wire ropes when run overhead.

Until within two years past nearly all the telephone wires used were run singly overhead, and, in many cases, as many as 1,200 wires were strung upon one system of poles and fixtures. But the constant interruptions experienced from the wires crossing one another, or the contact of telegraph wires, made it necessary to adopt the present system of cables, which, so far, seems to admirably meet the requirements of the service. The cost of these cables to the company is about $1 a foot.

The underground lines are all in Boston, and run from the main office on Pearl street. The longest now in use runs up through Franklin and across Washington street, a distance of 1,700 feet. The other lines are run through Pearl street, across Post-office square, through Congress to Exchange place, and to State street. It may be said that the wires in these underground cables are working fairly well, though not so well as in the aërial cables, the current through the underground wires seeming to be more sluggish. This is most noticeable when subscribers are connected with long lines which are beyond the underground cables, the great force of the current seeming to be lost before the aërial wires are reached. In this connection it may be well to state that the company has projected an extension of the present underground system from the corner of Arch and Franklin streets, through Chauncey to Harrison avenue, Beach and Lagrange streets, and up Tremont street, a distance of about two miles from the starting point. It is also contemplated to extend the underground system through Boylston to Berkeley street, and along Berkeley to Beacon, a distance of some 1,400 feet, and permission to lay these cables under ground has already been asked of the city authorities. These cables will take the place of the lines which now run through Copley square and Huntington avenue, and also the main line of poles and wires on Harrison avenue. This two-mile line of cable will, it is said, be longer than any underground telephone line now in operation in this country, and is as yet, of course, regarded as somewhat of an experiment to test the practicability of long telephone lines under ground. Telegraph lines have no doubt been worked through longer distances, but the more delicate telephone current may be found not to work so well.

In regard to the central office and its equipment, it may be said that in this office what is known as the multiple switch-board is in use, and serves about 2,000 subscribers. The same system has also been put in the branch offices on Tremont street and in Cambridge. This switch-board and its attachments represent the combined inventions of about 140 patents. It is located on the upper floor of the building, and appears to be one of the most complex affairs conceivable. It is about 70 feet in length and about 7 feet high. It is divided into 20 sections, each of which is constantly attended by an operator by night as well as by day, though, as the night service is small compared with that of the day, fewer operators are needed. In the daytime females are employed, and only men at night. Each of the 20 operators has about 100 lines to attend to, the subscribers on which, by ringing their bells, throw down a drop or small hinged shutter, on the inside of which is their number, and this is the signal of their desire to communicate with some others. After ascertaining their wants, the operator makes the connection with the subscriber or branch office desired without leaving her seat. To place all the subscribers in the district before each operator making the 2,000 connections within her reach, a system of cross-wiring had to be made, which required the making of 200,000 solder-joints and the use of 60,000 feet of cables of 20 copper wires each. The whole affair presents a perfect network of wires so complex as to be absolutely bewildering to the beholder.

On the floor below the general office are located the long-distance and express-line services. Over 500 merchants are, by this system, enabled to send orders to the 400 ex-

* *Boston Herald*, May 20, 1886.

press companies and expressmen doing business in the telephone company's district. The long-distance lines connected on this floor serve subscribers and others desiring to talk with persons in the various cities connected with the exchange, from Portland to Philadelphia. The company during the past year has built a copper line to Portland, which has worked well and is receiving good patronage. The long-distance transmitter used in the longer lines appears to be objectionable for short-distance service on account of its loudness and the uneven manner of its transmission.

About 250 persons are employed at the central and branch offices of the company of the Boston division. This force includes operators, inspectors, linemen and clerks. The total pay-roll of the company is about $8,600 a month.

The lines of subscribers and their instruments are tested each morning by the operator calling for subscribers. A written report of these tests is made to the chief inspector, whose duty it is to have the force under him correct and remedy all irregularities in communication. At the central office a force of ten men is constantly employed in making repairs of lines, adjusting and repairing instruments, and in visiting the premises of subscribers to inspect apparatus and keep the batteries in order. This force is in charge of the chief inspector, who keeps a record of all work done, and is in constant communication with his men while they are at work in the various parts of the district. Every interruption, etc., which may occur in the district is attended to on the day it is reported, unless made after 5 P. M., and those received after that hour are attended to the first thing the morning following.

The subscribers in Boston average about 7 6-10 calls per day each, and each operator enters about 700 calls a day. From the average time taken of two hours' service, it appears that to answer a call and make connection occupied just fourteen seconds, though some impatient subscribers may think this a long time to wait.

The apparatus and instruments used by the company are claimed to be the latest and best obtainable. The multiple switch-boards at the central office were put into service at an expense of $48,000. The old boards, which were discarded, cost over $20,000, and were sold for $800. The Blake transmitters and the Bell receivers, which are the property of the American Bell Telephone Company, are the instruments used. The company has an electrician, who is constantly engaged in making experiments, measuring lines to locate troubles, and, with the aid of assistants, testing and repairing the telephones in use. The aim has been, and is, to obtain and give to subscribers the best instruments, and large sums of money have been expended by the Bell Company to this end. The changes and improvements made by the New England Telephone and Telegraph Company have been very costly, and, as a consequence, the company has had to pass some dividends, the second one only being in process of payment at this time. It is supposed that the company is somewhat sensitive in regard to complaints of subscribers, but this is not the case. The officers invite complaints wherever a cause exists, and will be glad to remedy them. It has been found by experience, however, that the percentage of complaints of all kinds has been reduced about one-half within the past year. Every complaint made is recorded and at once receives attention from the central office. The officers acknowledge that a system involving so many details and liable to so many interruptions can never be perfect, but it is obvious that they should desire to have the business conducted with as little dissatisfaction to subscribers as possible, and they claim that they are doing all in their power to render satisfactory service. They invite subscribers to visit the central office and see for themselves what is being done there, and how the business is conducted in regard to its details. They are convinced that a better familiarity with what they are doing would tend to make their patrons more lenient, and, perhaps, more reasonable.

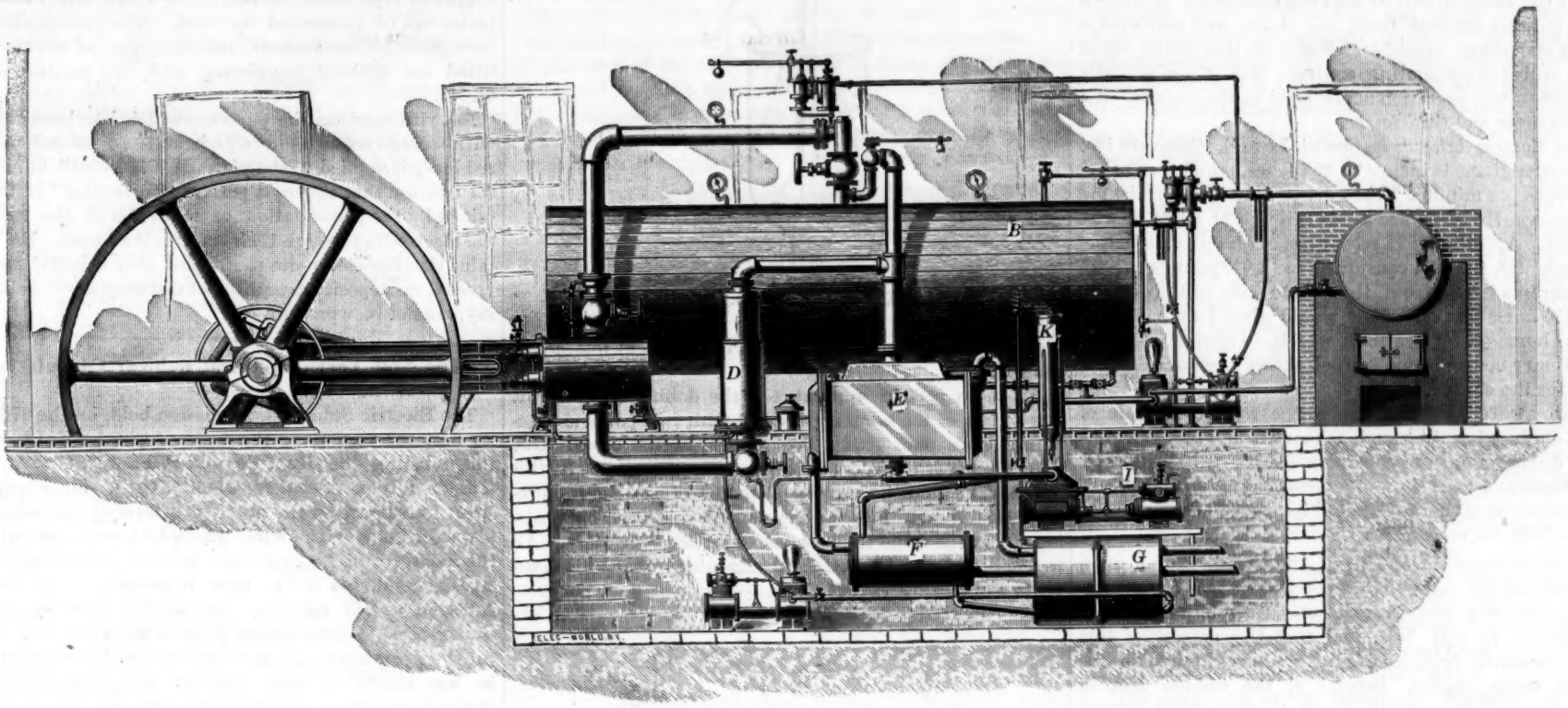


FIG. 1.—THE TRIPLE THERMIC MOTOR PLANT, LOWELL, MASS.

The Triple Thermic Motor in Electric Lighting.

For a number of months past the electric lighting station at Lowell, Mass., has been operated by an engine known as the "Triple Thermic Motor," of which much has been written, but of the exact nature of which very little has thus far been made known. General interest has, however, been aroused by the fact that the claims of efficiency made for the engine are greater than have before been attained with steam, and the more so that in the present instance bisulphide of carbon is employed as the working medium.

In order, therefore, to give our readers, many of whom are power users, an opportunity of judging the character of the plant, we propose to describe it in detail, so that they may obtain an intelligent idea of what the plant consists of. As stated above, instead of steam in the cylinder of the engine, bisulphide of carbon vapor is employed. This, in itself, is not new, and has, indeed, been tried on many former occasions, but with little success, and hence also the distrust which has naturally followed the announcement of the present attempt.

Before entering into a detailed description, it may be well to premise that while steam is employed in the working of the motor, it is only employed as a medium for the transference of heat, and is not caused to exert its expansive force in the cylinder. The steam generated in the boiler is brought in proximity to the bisulphide of carbon, which absorbs its heat, and is converted into a vapor at a corresponding pressure. This bisulphide of carbon vapor is then led to the cylinder of the engine, and exerts pressure on the piston. As the exhaust vapor leaves the cylinder it is made to give up its remaining heat to the liqnid bisulphide of carbon entering what is called the vapor "generator" described below. Steam is also admitted to the cylinder jacket, and in this way cylinder-condensation and consequent loss of pressure is almost entirely prevented. These items, taken in connection with the lower boiling point and latent heat of bisulphide of carbon, as compared with steam, may serve to explain the high duty which is claimed for this motor.

Our illustration, Fig. 1, represents the power plant on this system. Beginning with the boiler, the steam is led to the "vapor generator," *B*, passing through a regulating valve, which reduces its pressure, and consequently its temperature, considerably below that of the steam in the boiler. This vapor generator is shown in section in Fig. 2, and consists of a tubular boiler, incased and suspended in a surrounding shell. The internal boiler has a large number of tubes and contains the bisulphide of carbon, which is heated by the steam admitted into the other casing by the perforated pipe at the bottom, and which circulates it evenly. At the top of the vapor boiler there is a perforated pipe, which communicates with the outlet at the top, and which acts as a dry-pipe to separate the entrained liquid from the vapor. From this point the vapor is led to the cylinder of the engine through a pipe which is jacketed and surrounded by live steam from the boiler, which superheats it. The cylinder of the engine is similarly jacketed. The exhaust vapor, after it leaves the cylinder, passes out through a pipe, and is then led upward into a vertical heater, *D*, where it gives up part of its remaining heat to the cold bisulphide of carbon entering the vapor generator.

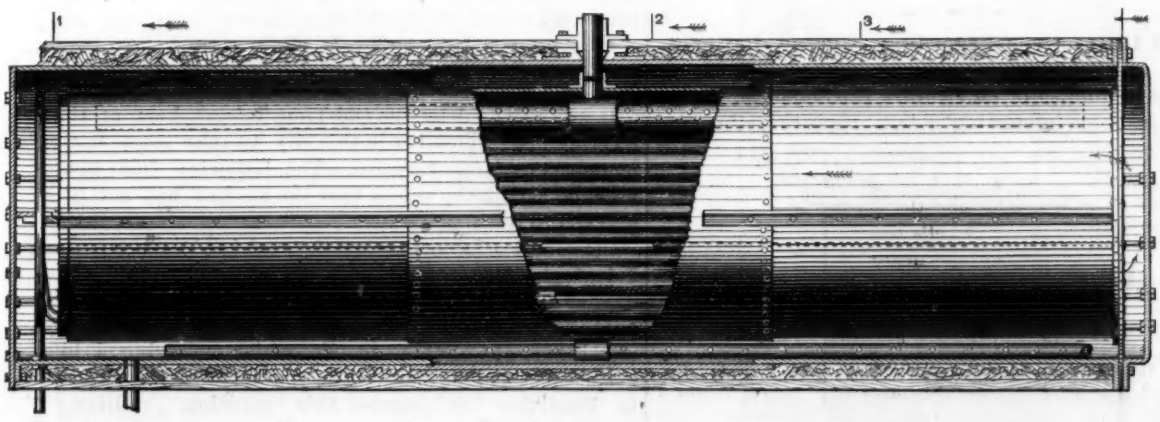


FIG. 2.—THE VAPOR GENERATOR.

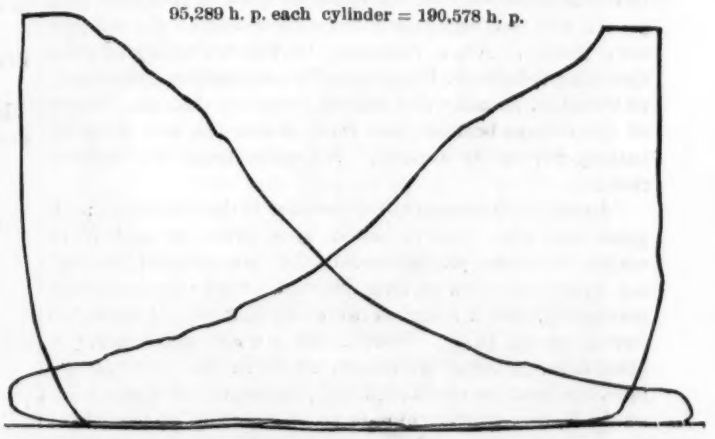


FIG. 3.—INDICATOR CARD.

From the heater the vapor passes on to the surface condenser, *E*, which is in the shape of a rectangular box, in which it passes around a series of tubes, through which cold water is kept in constant circulation. From this condenser the liquid bisulphide of carbon, the uncondensed vapor, etc., is drawn by a vacuum pump *I*, into the auxiliary condenser, *F*, where further condensation is effected. The liquid bisulphide finally passes into the well *G* provided with a glass sight gauge for observing the height of the liquid.

Any uncondensed vapor which may find its way into the well passes up through communicating tubes at the

top into a vertical "washer," *K*, where it passes through a body of water, at which point it is finally condensed and relieved of all impurities, which latter are drawn off.

We may remark here that it has been found that when the bisulphide has been at work in the engine for some time, and continually purified in this manner, it finally loses its pungent odor entirely, so that should any escape through a defective joint, its presence would not be obnoxious. In addition to the steam admitted to the vapor generator from the boiler, all the exhaust steam from the various pumps is led into it, so that the remaining heat of the exhaust is utilized in vaporizing the bisulphide of carbon.

From the above it will be seen the bisulphide of carbon is kept entirely distinct from the steam, and performs a cycle of operations entirely analogous to that of the steam in the ordinary condensing engine. The steam actually employed in this operation acts merely in the capacity of a heat conveyer and transferrer.

In the electric lighting station at Lowell, there are two Fitchburg engines, 14 inches by 28 inches, which run at 110 revolutions per minute. They drive dynamos furnishing 138 Thomson-Houston arc lights through 21 miles of wire in circuit. According to a recent test made during a period of eight hours, the fuel consumed was 2,012 pounds of coal, and diagrams taken from the engine with full load indicated 175 horse-power. This would give 1.43 pounds of coal per horse-power per hour, which, in comparison with the ordinary consumption of fuel, shows a remarkable efficiency for the engine.

We are aware that the experience with bisulphide of carbon engines has been such as to make any new attempts in this direction open to considerable harsh criticism. But if the results of tests show the economy given above, it must be admitted that substantial improvements have been made calling for recognition.

In illustration of the effects of the steam jacket upon the action of the vapor in the cylinder, we give the accompanying indicator diagram and notes, Fig. 3, taken from the engine. It will be noted that the expansion line differs materially from its usual form, as exhibited in the cards of steam engine. Instead of the sudden drop in pressure with such an early cut-off, the line drops gradually, showing that pressure is well maintained and is due to the heat acquired from the jacket.

A Secondary Battery of Twenty-five Years Ago.

During the discussion of Mr. Bauer's paper, read before the American Institute of Electrical Engineers, on "Secondary Batteries for Lighting and Power," which we print in another column, reference was made to the work of an early inventor, to whom also Mr. C. J. Kintner referred in his lecture before the Franklin Institute [ELEC. WORLD, May 15]. Inquiry having been made on the subject, we may say that this inventor, Charles Kirchhof, in a patent granted to him Feb. 26, 1861, describes a form of storage battery to which many inventors of the present day are referred to by the examiners in the Patent Office, and it may therefore prove of interest to our readers to learn of the work of a man who was so far in advance of his time and who came so near the solution of the problem of the practical application of the storage battery.

The patent referred to shows that Kirchhof possessed an intimate knowledge of the previous work in this field, and proves also that he himself must have studied the subject very deeply. After referring to Ritter's charging-pile, Grove's gas-battery, Poggendorff's polarization apparatus, to Faraday, Mendler and others, he enters into the theory of the storage battery, and then shows the new form of battery devised by himself. We quote from his description:

"A small and powerful regenerator is the following: A glass (see Fig. 1), *A*, is closed by a cover of lead, *B*, to which electrodes of platina-foil, *C C*, are soldered, diverging from each other as they descend. Said electrodes are perforated, and I roughen them by hammering them between emery paper. They need not be platinized. A glass tube, *E*, inserted through a hole in the cover *B*, isolates the positive electrode *D* of platina, which is suspended in it, and nearly extends to the bottom of the glass, where it spreads and branches around, without touching, however, the other platina-foil. The glass is filled up with a solution consisting of about six parts (by weight) of nitrate of lead, two or three parts of acetate of lead, and one part of nitrate of potash, dissolved in from eight to twelve times the quantity of water. The solution is now filtered and the following added: four parts of acetic acid (liquid commercial at twenty-one per cent.), one part of nitric acid, and scarcely one-sixteenth part of nitrate or acetate of iron (or nitrate or acetate of zinc). When too much of the iron is taken, the turning of the light color of the solution into a yellowish one will indicate it. On connecting the cover *B* with the positive pole *P* and the isolated electrode *D* with the negative end *Z* of any generator, the foil will turn black peroxide of lead, and the positive electrode will be surrounded by crystallized lead. This is a very positive element, and the former (peroxide) the most negative known to exist, and also a good conductor.

"By changing the proportions of the substances of the solution, more or less peroxide or metal will be deposited, and the conducting power, etc., may be increased or decreased in the same ratio. If pure ingredients are employed in the preparation of the solution, it will last for a long time.

"Metals of a more negative character than the above-named lead (except quicksilver) covering the positive electrodes are often very injurious. This is not the case, however, with the more positive elements. The combination of several cups or glasses is the same as in galvanic batteries.

"Platina may be saved by substituting a positive elec-

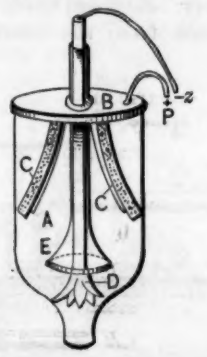


FIG. 1.—KIRCHHOF'S STORAGE BATTERY.

trode of lead (amalgamated with quicksilver) instead of platina.

"A more perfect apparatus is the double regenerator. Each glass of the same is provided with two pairs of electrodes, each pair acting independent of the other. One pair discharges while the other gets charged. In this manner the quantity of the elements of the solution remains the same. In some cases one positive electrode may answer at the same time for the two negative ones. All regenerators may be used for discharging quantitative currents while being charged."

The patent also describes a "translator," Fig. 2, the ob-

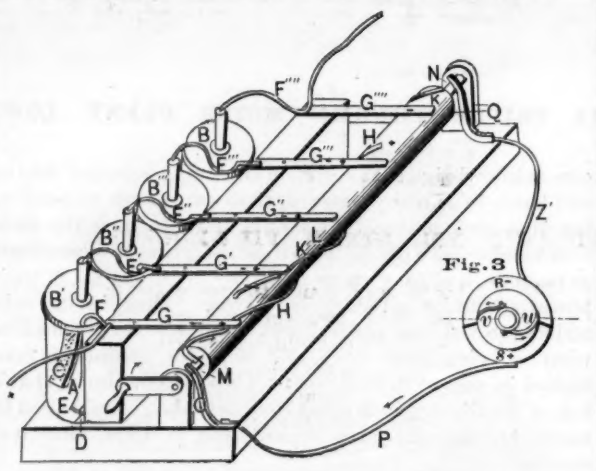
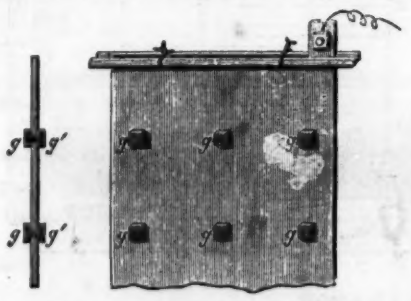


FIG. 2.—KIRCHHOF'S STORAGE BATTERY.

ject of which is to charge each battery in succession, while the others of the same circuit are discharging, Fig. 3 representing the commutator of a magneto-electric machine. The points given above are those regarding which curiosity has been aroused, and which constitute the main elements of the patent.

Practical Instructions Regarding Storage Batteries.

In a recent number of *La Lumière Electrique*, M. Gaston Planté gives some interesting details regarding the con-



PLANTÉ'S STORAGE BATTERY.

struction of storage batteries, and his long experience with them makes his observations of great value.

He points out that the separation of the electrodes is a matter of the greatest importance. Since 1860, when he first entered upon this field of research, M. Planté has employed a great many different methods to effect the separation, such as elastic rubber bands, strips of gutta percha, or sticks of wood tarred or paraffined. The latest method, which is also very simple, is the following: The lead plates are kept apart by a series of "double-buttons" of gutta percha, as *g g'*, shown in the accompanying illustration; these are placed about 4 inches apart, but may be placed closer so as to avoid any possible contact of the plates. In order to attach the buttons firmly the alternate plates are perforated with holes about 4 inches in diameter, and a cube or small cylinder of gutta percha is pressed against each.

The gutta percha is first softened by the heat of a can dle or alcohol lamp, and then a similar piece is pressed in from the other side of the plate. The two pieces unite at the joint and form the double button *g g'*, which adheres firmly to the plates and assures their insulation. As stated before, it suffices to treat only the alternate plates in this manner.

The plates are suspended by means of strips of wood attached to them by lead wires, the ends of the strips resting against the sides of the containing vessel. These wires, however, must be placed on the adjacent plates so as not to touch one another.

The projecting piece of each plate is varnished or dipped in a resinous mastic and provided with a nut of copper or type metal, by means of which any number of plates can be connected by bars. The independence of each plate is thus assured, and any one of them can be lifted out without interfering with the position of the others.

Notwithstanding the success which has been attained with storage batteries in which active material, such as red lead, is applied to the plate, M. Planté still adheres to the opinion that the most perfect "formation" is that obtained by the peroxidation or reduction of the metal of the electrodes through their entire thickness. He maintains that the electrodes so formed (his original method) present no deposit susceptible of disintegration, and, so to say, cannot be worn out.

The New York Electrical Subway Commission.

The Electric Subway Commission held, on the 27th ult., its first meeting since the death of Charles E. Loew. At this meeting the Hon. Roswell P. Flower, the new Commissioner, took his seat for the first time. Mr. Flower had spent four hours on the previous afternoon examining the plans for burying the wires which had been submitted to the board, and he expressed himself as having a pretty good general idea of the most important of the systems. As soon as the meeting was called to order by Commissioner Moss, Commissioner Hess nominated Mr. Flower for the Presidency, made vacant by Mr. Loew's death, and he was elected to that position. He acknowledged the honor done him by his associates, but said he would not make a speech, but go to work at once and see if he could not, with the other Commissioners, make a record for the board and himself. He announced his intention of taking a trip to Chicago, Philadelphia, Washington and Baltimore, to examine the practical working of the Dorsett, Johnstone and other systems in operation in those cities. This, he thought, would occupy him about two weeks, and he believed that on his return he would be ready to take up the work of the Commission without further preliminary preparation.

The board passed resolutions of respect to the memory of Charles E. Loew, its former President, and then adjourned. Mr. Moss, in speaking of the meeting, said: "Mr. Flower showed that he is thoroughly in earnest in his desire to get at the work of burying the wires under ground at once. He is a practical business man, and he will treat the problem with business methods. I see no reason why we should not adopt some feasible system, and get down to effective work before the end of June." Mr. Flower left for Chicago last week. The Commission is still willing to listen to the advocacy of any underground plans that have not yet received attention, but it believes that all the systems at all likely to have merit have already been presented.

Honors To An Early Telegrapher.

It was proposed by the Old-Time Telegraphers at their meeting last September in this city to raise some lasting memorial to James Leonard. The following from Louisville, of May 27th, shows that the subject has not been allowed to rest:

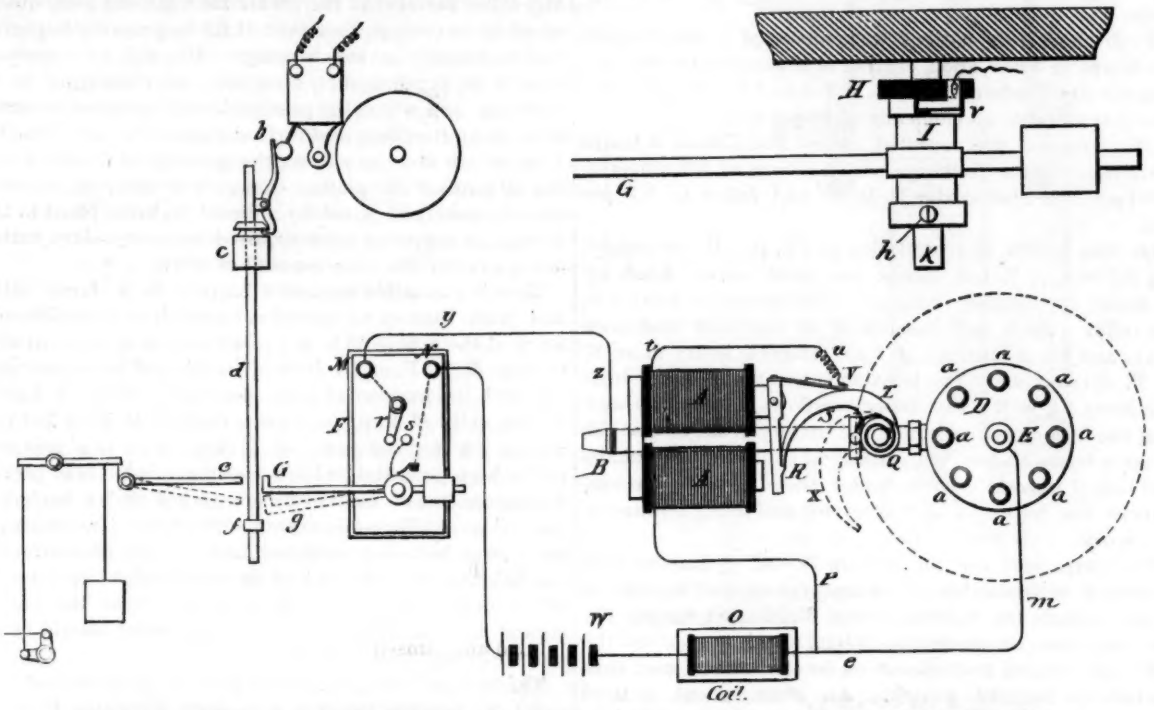
Col. Charles Taylor, the manager of the Western Union Telegraph office at Frankfort, passed through the city today, en route from Columbus, Miss., to Kentucky's capital with the remains of James F. Leonard, who died of typhoid fever at Columbus in 1862 while managing a telegraph office at that place. The remains were forwarded to Frankfort by express this morning. "Jimmy" Leonard was the originator of reading telegrams by sound, and when he first suggested that such a thing was possible operators all over the land considered it preposterous and hooted at the idea. The young Frankfort operator, however, insisted that he could read an instrument by sound equally as well as he could from the paper tape, and in order to try him several other operators assembled at his office at Frankfort. Leonard stood with his back to the instrument, and as the dots and dashes rolled off he read the many messages fluently, and wrote them out in full. This was a new and great feature for the telegraphic fraternity, and almost like magic the idea spread, and the practice of reading by sound became general, until at last it became such a common science that to-day an operator who cannot read by sound is considered worthless.

At the last meeting of the Old Time Telegraphers' Association at New York City, a resolution was passed to have the remains of Jimmy Leonard removed from Columbus to his old home at Frankfort, there to be laid away beside Daniel Boone and many other noted Kentuckians, and

that a monument be erected to his memory. To carry out this purpose Captain George M. Dugan, of Jackson, Tenn.; Edward Hogshead, of Meridian, Miss., and Col. C. E. Taylor, of Frankfort, Ky., were made a committee to solicit funds and tranfer the remains. The monument will be a very handsome one, upon one side of which will be a circuit of telegraph wires on poles, which connects with a key, and this has a nimble hand working it. Another side bears the name and dates, while the other two sides bear mottos suitable for their places. It has not been determined yet whether any big spread will be made when the monument is unveiled, which will be in July; but this is more than likely, as all the telegraphers for several States around are interested in the honors thus conferred.

Automatic Fire-Lighter for Steam Fire-Engines.

Nowhere, perhaps, is the rapidity of action of the electric current taken advantage of in more numerous ways than in the equipment of the modern fire departments. Not only are the alarms sent in by telegraph, but



FIGS. 1 AND 2.—AUTOMATIC FIRE-LIGHTER FOR STEAM FIRE-ENGINES.

even the horses are unhitched and the fire under the engine is lighted by the same medium—electricity. An apparatus designed for the latter purposes has recently been constructed for the fire department of Havana, Cuba, by Mr. A. L. Bogart, of this city. It possesses several interesting features, and may well command the attention of those in charge of American fire departments.

Mr. Bogart employs the gong-striker to release a weight which, through a number of simple devices, acts both to unhitch the horses in the stalls and to kindle the fire under the boiler of the engine. Our illustration, Fig. 1, is a diagramatic view of the parts of the apparatus.

Beginning with the unhitching device, it will be seen to consist of a brass weight *c*, which slides freely upon a rod *d*, and is normally held in position by means of the catch *b*. The upper end of this catch is in close proximity to the electric gong-striker that sounds the fire signals, and so placed that the hammer of the gong strikes the catch on its back stroke, and thus releases the weight, permitting it to slide down the rod. In its fall it strikes the lever *e*, and frees a heavy weight which, by proper mechanism, unhitches the horses.

The fire-lighting apparatus consists of a heavy cast iron base *E*, upon which are mounted a cluster of Bunsen burners *a*, *a*, *a*, and in the centre a vibrating electric gas burner. The end of the supply-pipe *B* is attached to a rubber hose in connection with the gas supply, and a stop-cock *Q* shuts off the gas from the burners. The gas-cock carries a lever which engages with a catch placed on the armature *R* of the electro-magnet *A A*, and an insulating strip is made fast to a spring *V*, attached to the pivoted end of the armature.

It remains only to describe the device for closing the circuit. This is accomplished by the lever *G*, which is pivoted to the board *F* and is shown in detail in Fig. 2. The lever and its bearing *h* is of brass, and revolves freely on the fixed shaft *K*. A spring *v* has one end screwed fast to the disc *H*, the other end resting upon the insulating piece *I* of the movable bearing, when the lever *G* is horizontal. When the lever is thrown down by the weight, the insulating piece is moved from under the spring *v*, and the circuit is complete through the metal bearing.

With the first signal upon the bell, the weight descends so as to unhitch the horses and to close the electrical circuit. The current passes from the battery through the spark coil *C*, and there splits, the greater portion passing through *P* to the helices of the electro magnets *A A*; the return circuit being through the contact *V* and the gas pipe to *B*, *z*, *y*, etc. The magnets attract the armature *R*, and release the cock-lever, so that the gas is admitted to the burners. The movement of the cock-lever, however, causes the spring to bear upon the insulating strip, so that now the full current is led through the wire *e m* to the vibrating burner *E*, which ignites the gas flowing therefrom, and that in turn ignites the other burners. In action this apparatus, which it has taken so long to describe, is practically instantaneous, and it would make a valuable addition to many fire-engine houses.

The Conversion of Natural Forces.

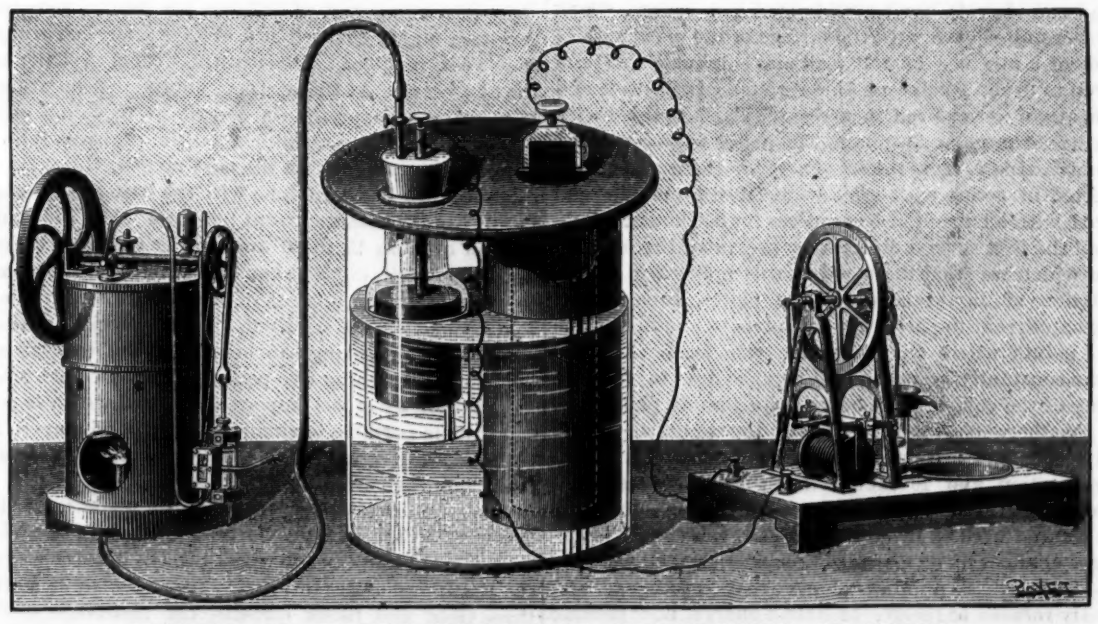
Numerous experiments have been devised to demonstrate the principle of the conservation of energy and the convertibility of one form of energy into another. One of the more recent, and one quite neat in its way is that described by a correspondent of *La Nature* and illustrated in the accompanying engraving. It consists of an electric battery which is the source of energy that drives simultaneously an electric motor and a steam engine.

The zinc of the battery, instead of being the usual hollow cylinder, is in this case a solid cylinder, which is suspended under a glass bell-jar. The top of the latter passes through the wooden cover, which must be made to seal the jar hermetically by means of wax or mastic.

The bell-jar passes through the cover and is closed by a rubber stopper with two perforations. Through one of these passes a copper rod which supports the zinc, while through the other passes a tube with a stop-cock by which the hydrogen gas generated escapes. The opening and closing of this stop-cock, strange as it may seem, opens and closes the electric circuit, for when the cock is open the gas escapes; but when closed the gas accumulates, drives the liquid out of the bell-jar and finally out of contact with the zinc, when, of course, the circuit is broken and all action ceases.

At the side of the bell-jar is placed the ordinary carbon in the porous jar and nitric acid.

As the illustration shows, the electricity generated by the battery is conducted to an electro-motor operating a pump; while the hydrogen is led through a rubber tube to a model steam-engine, where it is lighted and heats the little boiler, generating steam which drives the engine.



METHOD OF ILLUSTRATING THE CORRELATION OF FORCES.

The Cowles Process.—The corundum to be worked by the Cowles electric smelting process at Lockport, N. Y., is procured from the Blue Ridge Mountains of North Carolina, where it is found in masses of from 600 to 800 pounds. The yield of aluminium from the corundum is set at about 50 per cent. The alloy to be made at the works will require not less than ten tons of copper daily.

The President's Love Telegram.

The *National Republican*, of Washington, gives an interesting account of how the secret of the President's engagement first leaked out. It says: "A telegraph operator in this city was the first person outside of the Cleveland and Folsom families to discover the fact of the President's engagement. This knowledge, however, proved very unfortunate for him and resulted ultimately in the loss of his situation. On the night preceding Miss Folsom's departure for Europe a telegram written by the President was handed in at the telegraph office. It was addressed to Miss Folsom. The operator who sent the dispatch has a mania for autographs. He made a copy of the original despatch, which he filed with the others transmitted by him, and carried the original home, his intention being to cut off the signature and place it among his other collections. Both his wife and his landlady were shown the dispatch. It contained sentiments of such nature as to leave no doubt in their minds that a love affair, to say the least, was on the tapis, and this secret each solemnly resolved to respect. In the course of time a disagreement occurred between the two ladies, which resulted in the operator and his wife seeking other quarters. The landlady in revenge called at the telegraph office and reported to the proper officials the operator's connection with the stolen dispatch. The operator made no denial of the charges against him, but said he had intended no harm. He had, however, broken an inviolable rule of the company, and was given a week in which to resign, and now he is looking for another job. The news then leaked out, and a friend of the publisher of a little country paper sent out the fact. No notice was taken of the obscure paragraph for some time, when a New York paper took it up and it became general."

A Verdict for Bell at New Orleans.

At New Orleans on May 31, Judges Pardee and Billings, in the United States Circuit Court, sitting in banc, rendered a decision in the case of the American Bell Telephone Company against the National Improved Telephone Company. In summing up the judges say:

The merit and, as we think, the originality of the Bell invention consisted in the discovery of the law and in the construction of the apparatus, so that when the sound caused aërial movements or vibrations they might, without any intermission of the current, be freely transferred or translated into electrical undulations, which again at the end of the current would freely reproduce the aërial vibrations and thus convey, single or combined, transmitted sounds to the ear and continue to convey them without interruptions, as originally uttered, whether single, combined or successive. A great fact in proof of the correctness of this deduction is that the instruments invented by Reis and his methods were described in many scientific papers and works, and were well known in the scientific world, and the instruments were manufactured and on sale in Paris, Vienna and Frankfort, and had been exhibited before the British Association. A pair were deposited in the Smithsonian Institution, and yet before 1876 there was no speaking telephone in use or any pretense of any. The various reproductions of Reis and his methods all were based upon the same defective electrical means—an intermittent current.

There remains, therefore, but the question of infringement. This matter has not been squarely met by the defendants. The complainants' bill alleges, and their experts testify in the opening papers, that the instruments used by the defendants consist of a microphone transmitter and a magneto receiver, which has been decided in the Spencer and Molecular cases to be an infringement. The defendants in their answer (unsworn to), in a vague and augumentative way deny the infringement. In their affidavits they do not attempt to show what they were using at the filing of the bill, but they allege in affidavits, filed pending this motion, that defendants' apparatus as now

used may be more particularly defined as operating, in method or principle of operation, under the Reis inventions of 1860-64 and under special inventions patented by Randall, May 21, 1878, May 4, 1880, and May 3, 1881, and all were practical failures for the transmission of speech until Bell's method was discovered. From the evidence submitted in this case it seems clear that now, in the present state of the art, neither the Reis instruments nor any reproduction of them can be made to transmit articulate speech, except by changes of some form in the instruments themselves, or by the employment of Bell's methods. We, therefore, conclude that neither Reis nor his successors anticipated the invention of Bell as set forth in the fifth claim of his application and patent, and as illustrated by Fig. 7 described in his accompanying specification. The injunction against the defendant company is ordered to issue.

Secondary Batteries for Light and Power.*

BY A. H. BAUER.

So much has been written of the theory of secondary batteries that I assume it would be more interesting to the members of this Institute to confine my remarks to a history of what has been done practically during the past three years with the Faure battery at Baltimore.

In May, 1882, a set of Faure batteries was brought from Paris by the steamer "Labrador," and sent to Baltimore. This battery was composed of 60 cells, each containing ten plates, with a supposed capacity of 200 ampère hours at an E. M. F. of 2 volts. The plates were made of sheet lead, 9½ inches long, 5½ inches wide and $\frac{1}{16}$ inch thick, mechanically perforated with 400 holes ⅛ inch diameter. They were coated with a paste made by mixing sulphuric acid and red lead, which was held in place by wrapping the plate in felt. They were set in lead-lined boxes, with the terminals of five plates joined together with brass clamps to form the positive, and the remaining five likewise connected to form the negative poles. Twenty-four of these cells were placed on exhibition in the offices of the Electric Storage Company, and arranged to run a lot of Edison B lamps, small motors, etc. The charging machine was an Edison Z dynamo, located about half a mile from the office.

These batteries gave satisfactory service for about six months, when they failed rapidly—first one, and then another, would refuse to store, until nearly all had become useless. Examination disclosed many causes for the failure, which at that time was imperfectly understood. One of the defects was the interposition of felt between the plates, which increased the internal resistance; and after a time the felt got rotten and fell off, causing a short circuit.

Realizing these and other defects, the matter was taken in hand with the intention of evolving a practical battery, with what results the following will show:

The first plate giving promise of success was cast in an iron mold; its dimensions were 12½ inches long, 9½ inches wide, and ⅜ inch thick, weighing 6½ pounds. They were in the form of grids, having 480 holes ⅜ inch square. These holes were filled even with the surface of the plate with 5½ pounds of a mixture of red lead and sulphuric acid, and allowed to dry. Twelve of these plates (six positive and six negative) were placed in a rectangular box lined with a mixture of pitch and asphalt. The plates were separated by pine boards $\frac{1}{32}$ inch thick. Forty of these cells were connected in series with an Edison 110-volt machine and charged with a current of 50 ampères for 300 hours.

From the first several difficulties presented themselves, one of which was that the wood boards prevented a free circulation of liquid between the plates, causing the charging current to pass from one plate to another at one or two points where the resistance was least. Another was the constantly increasing resistance due to the sulphating of the copper connecting strips joining plates and cells together. The next step was the removal of the wood boards and the substitution of pine strips ¼ inch square section and 10 inches long; four of these were placed between each pair of plates; the copper connectors were painted with an insulating paint.

These changes made a vast improvement in the working of the battery. A number of cells that before had persistently refused to receive or hold a charge, now became active and could be relied upon to give a satisfactory current. While with the same plates separated by boards, the internal resistance of the cells averaged $\frac{1}{175}$ ohm, that of the same cells with ¼ inch strips fell to $\frac{1}{400}$ ohm. In the course of time, however, the copper connecting strips gave trouble. In spite of the insulating paint, the acid would attack the strips, forming sulphate and developing a high resistance.

While much had been learned from these experiments, and some progress had been made towards a practical battery, yet it was seen that the great weight (250 lbs.) per cell of those in service must be reduced. About this time the writer visited London, for the purpose of studying the improvements made by the Electric Power Storage Company at Milwall. Immediately upon his return the subject was taken up anew. It was found necessary to make numerous changes. While the cast perforated plate was still used, its dimensions were reduced to 10 inches long, 9½ inches wide, and $\frac{3}{16}$ inch thick, and its weight to 2½ pounds. These plates were pasted with 2½ pounds of active material. The only size cell made at that time was termed a 1 h. p. cell, and consisted of 16 plates (8 + and 8 —) in a lead-lined box, separated by pine strips ¼ inch square section.

They had a capacity of 370 ampère hours at 2 volts E. M. F.,

$$\frac{2 \times 370}{746} = 1 \text{ El. h. p.}$$

Instead of using copper or brass rods, or strips for connecting the plates and cells together, lead was substituted. This battery showed a great improvement over the first made. It was found to be thoroughly reliable. It would retain its charge for months without practical loss. Numerous experiments were made to determine their capacity and efficiency. These tests have always been of a practical nature—two of which I will quote: 32 cells were charged with 20 ampères for 20 hours. A carefully calibrated ammeter was kept in circuit during the entire time.

To discharge, the battery was connected to two Weston arc lamps in series, and a current of 20 ampères for 16 hours was obtained before the E. M. F. fell to 1.5 volts per cell; this was equal to an efficiency of 80 per cent.

The same test was repeated, except that Edison B lamps were used for the discharge with a return of 340 ampères, or 94 per cent., before the E. M. F. had fallen to 1.5 per cell.

On May 1, 1884, an installation of 3 h. p. cells for supplying 255 16 c. p. 70-volt lamps was made at the Academy of Music, for lighting the stage. This battery is located in the cellar. Each cell consists of 48 plates in lead-lined boxes and has a capacity of 1,200 ampère hours at an E. M. F. of two volts. The location is not the best for high efficiency; a well occasionally overflows, thoroughly wetting the framework on which the battery rests, as also the wooden boxes themselves, causing at times serious leakage and loss of current. Even under these adverse circumstances the battery is still in service and doing remunerative work.

The lamps used are the Weston 70 volt. $\frac{9}{10}$ ampère, and consist of 98 footlights of various colors, five borders of 20 lamps each, the balance being distributed among the dressing-rooms, stage entrances, etc. Each border and the different colored footlights is on its own circuit and controlled by its own switch. An arrangement is used whereby the light can be raised or lowered from the stage by adding or subtracting any number of cells from 1 to 16, as desired, thus producing all the effects that heretofore had been done with gas. This battery is charged every night with two 10-light arc machines, giving a total of 50 ampères.

It is of course understood that during the time of a performance a current of about 230 ampères was required to maintain the lamps, of which the dynamos furnished 50 and the batteries the balance. As this demand was not continuous during a performance, the total time not being over 4 hours in 24, it is possible by running the two machines for an average of 10 hours per day to keep the battery thoroughly charged and always ready to furnish current when required. This plant has been in daily service for two years. At this writing another installation of 3 h. p. cells for supplying 300 38-volt Swan lamps is being made for the Crescent Club of Baltimore, and will probably be in service within the next month.

Some work has been done with the batteries for cautery, faradic and constant current purposes. For the cautery a current of from 10 to 30 ampères is required, depending upon the length of platinum wire to be heated, and as they are in service not more than one minute at any one time, small capacities are required. These batteries are made up with plates measuring 7 inches long, 5 inches wide and $\frac{9}{16}$ inch thick, weighing two pounds. For office practice they have a capacity of 200 ampère hours, and weigh 43 pounds; those made portable having a capacity of 25 ampère hours, and weighing eight pounds. They usually run from three to six months without recharging.

A very interesting experiment was made a short time ago with 50 secondary cells on the wires of the Western Union Telegraph Co. A wire from the battery was run to the Baltimore office, to which was connected 38 Morse and three Gold and Stock circuits, the resistance of which varied from 50 to 6,000 ohms. At the same time three incandescent circuits, consisting of 56 Maxim 25 c. p. and 24 Edison 8 c. p. lamps were also being supplied from the same battery. The number of cells of primary battery displaced was 1,875 gravity and 110 carbon. The experiment was continued daily for more than one week.

[Here Mr. Bauer described his electric tramcar, run by storage batteries, a full description of which appeared in our issue of May 15.]

When the announcement was first made of the great discovery by Camille Faure, it was also said that the secondary battery was a simple contrivance composed of lead and sulphuric acid put together in certain proportions placed in wooden boxes, carted around the city and delivered to subscribers at stated times, that it could be placed in the cellar, vault, or some other out-of-the-way place, and without any attention whatever would always be ready to furnish current at any moment, either day or night. Such ideas instilled into the minds of an unthinking public have done great injury to the battery interests. A little thought and study would have shown the fallacy of these promises.

A secondary battery requires precisely the same amount of care and attention as a dynamo or other source of electrical energy doing the same amount of work. As a matter of comparison, suppose the plant at the Baltimore Academy of Music to be run from a dynamo capable of maintaining 255 16 c. p. lamps. In addition to the dynamo a 30 h. p. engine and boiler will be required. Now to properly take care of the installation it will be necessary that at least one man give it his entire time and attention. At stated times the boiler will be thoroughly examined. He will probably use a compound in the feed-water or take other means to remove scale. He will watch his gauges very closely to see that the proper quantity of water is in the boiler. His engine will be set perfectly level on at least a six-foot foundation, and all its moving parts closely watched to prevent an accident and stoppage. If he be attentive the engine will be kept scrupulously clean. His dynamo will receive as much if not more attention than any other member of the plant. He will use a good quality of oil in its cups and see that it feeds properly to prevent undue friction in the bearings. He will be extremely careful to prevent dirt, dust, etc., accumulating on the machine, and whenever possible he will remove the armature, clean it of dust and dirt, and give it a coat of shellac. If he be attentive he will see the necessity of closely watching all parts of the plant. Compare all this care and attention absolutely required by a direct lighting plant to that heretofore supposed to be required by a secondary battery doing exactly the same amount of work.

How is it possible to place a battery in a damp cellar, and with little or no attention expect it to do satisfactory work at the rate of 25 h. p.? Batteries as now constructed have an E. M. F. of 2 volts and an internal resistance varying with the number of plates per cell. Given a battery of 100 cells (3 h. p.) we have a total E. M. F. of 200 volts and an internal resistance of $\frac{1}{300}$ ohm; with this comparatively high potential and low resistance, what is to prevent a constant loss of current by creeping if such a battery is located in a cellar and covered with dirt and moisture? I have seen batteries working under such unsatisfactory conditions. On account of its great weight and the fact of sulphuric acid being used, it is best that the battery should be placed in a cellar, but the cellar should be dry and clean and well ventilated.

The first and most important point to be observed is to carefully insulate the cells from each other and from the earth. The plan I have adopted is to use 4 by 4 scantling well painted with asphalt varnish—the scantling is insulated from the earth, by the ordinary pin and glass, the glass being inverted and kept filled with paraffin oil. On the scantling are placed large porcelain insulators, four for each cell—on which the cells are set—the cells are kept one inch apart so as to allow a free circulation of air around the boxes, which keeps them dry. As the tops of all the boxes are on the same level and about three feet from the floor, they can be easily examined. A reliable voltmeter and hydrometer should be provided, so that each cell can be tested every day or two, to discover if any one is becoming faulty. Sometimes a square of active material will drop out, and lodge on the positive and negative plates, making a circuit of comparatively low resistance between the two, which will in time completely discharge the cell. A test with a voltmeter will indicate a fall of potential, and the hydrometer will show a fall in the strength of the acid solution in a cell so troubled, and the cause may be removed in a few moments. A fault of this kind will probably be understood when it is explained that the plates of a secondary battery contract when being charged, and expand while being discharged.

If the correct strength of solution has been used when the battery is first set up, a good hydrometer will also indicate the amount of current that has been taken out, which should not exceed 85 per cent. of the capacity.

Right here I would remark that within certain limits it is impossible to overcharge a battery—but it can be completely destroyed in a very short time by over-discharging. During discharge sulphate of lead is formed, and that is the destroying agent in secondary batteries.

In conclusion, I wish to emphasize the assertion that secondary batteries have passed beyond the experimental stage. They must, however, be properly constructed; they must also have a capacity proportionate to the work they are intended to do. Such a battery can be placed in the hands of any one of ordinary intelligence who, if he follows instructions and will give it the same amount of attention required by mechanism doing the same quantity of work, will meet with little or no trouble; on the contrary, the battery will be found always ready to furnish current at its maximum potential.

* Read before the American Institute of Electrical Engineers, New York, May 19, 1886.

Thunderstorm in a Clear Sky.—Captain Anderson, of the British bark Siddartha, which arrived in New York recently, reported a peculiar thunderstorm on April 27, while on the northern edge of the Gulf Stream. The sky was quite clear at the time, and the sun shining brightly, although there appeared to be a thin mist about the ship. Suddenly there appeared a vivid flash of lightning, accompanied by violent thunder. The compass was caused to vibrate perceptibly for a period of fifteen minutes.

The Gray Caveat.

In the most recent of his affidavits Zenas F. Wilber again avers that he unlawfully made known to Prof. Bell the contents of Elisha Gray's caveat in 1876, and that thereupon Prof. Bell so modified the wording and contents of his patent as to forestall Gray. It will therefore, no doubt, interest many to know the exact nature of this caveat and the device which it describes, the more so as this will probably be one of the chief points at issue in the approaching government suit. The caveat and accompanying drawings are published in full herewith. Wilber's affidavit was given in full in our last issue. Below is a statement from the Bell counsel, Mr. E. N. Dickerson, meeting the points raised :

"This affidavit of Wilber is the most discreditable and most imbecile performance that the Pan-Electric people have resorted to. Its object is to impress the community with the belief that Prof. Bell bribed the Examiner of the Patent Office to show him the Gray caveat, and that he appropriated the contents of that caveat and incorporated it into his patent. The material facts in this business are all on record, and there is no room for affidavits.

"They are simply these : On Jan. 20, 1876, Prof. Bell swore to his specification, the title of which is, 'An Improvement in Telegraphy.' That specification, in so far as it relates to the telephone, was patented in exactly the words in which it was originally sworn to, and has been sustained by every court to which it has been presented. It was filed in the Patent Office on the morning of Feb. 14, 1876, and was in Wilber's hands for official action before 12 o'clock of that day. This specification describes two plans for working the 'undulatory' method which results in the telephone, but gives the drawing of one of those plans commonly known as the 'magneto telephone.' The other plan is suggested in a general description. These are some of the words of that description : For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury or other liquid the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current.

"On the afternoon of Feb. 14, Gray filed a caveat suggesting a form of telephone in which a conducting wire was immersed more or less in a liquid, exactly according to the plan proposed in Bell's application. Thereupon Wilber, without noticing that Gray's caveat was filed later than Bell's application, gave notice to both parties of an interference between them, and wrote to Gray a letter pointing out specifically that his liquid plan was described in the Bell application. Upon inquiry by Bell's attorney, it appeared that Gray's caveat was filed too late, and the question was submitted to the Commissioner of Patents, who wrote an opinion deciding that Gray was not entitled to notice, and dissolving the interference, provided the fact was as stated.

"That question was investigated by Wilber, and he reported the fact as it is, that Gray's caveat was filed later than Bell's application. The consequence was Bell's application proceeded to examination, and nothing was found to anticipate it. Bell arrived in Washington after the interference had been dissolved, and when the caveat had ceased to be of any consequence. At that time Bell was very poor, having scarcely money enough to pay his expenses to Washington, and, of course, not having hundred dollar bills to scatter around the Patent Office.

"Wilber's story now is that he voluntarily showed Bell Gray's caveat, and that later on the same day Bell voluntarily gave him $100. If it had been true that Wilber showed the caveat, it would have been of no importance whatever, because the Bell specification, sworn to on Jan. 20, had in it the same matter that was in the caveat, which was not written until Feb. 14, and notice had been given to both parties of that fact before Bell went to Washington.

"When Bell was conversing with Wilber, however, after the interference had been dissolved, he asked Wilber what the point of interference had been, and Wilber pointed out to Bell in Bell's specification the passage above quoted, and which is the same in substance as the Gray caveat. But Wilber, probably angry at being overruled by the Commissioner of Patents, determined to bring on an interference between Gray and Bell, and accordingly on March 8, after he had found that Bell's patent could not be rejected, he went to Mr. Baldwin, Gray's attorney, showed him Bell's specification, told him that the Bell patent must issue unless Gray would come in and interfere, and invited an interference.

"Thereupon Mr. Baldwin wrote a letter to Gray, giving him this information, privately communicated to him by Wilber, in violation of the rules of the office, and invited him to file an application and bring on an interference. Gray, knowing that he had never done anything except to write that caveat on Feb. 14, and that therefore he had no rights whatever as against Bell, declined to accept the suggestion, and the Bell patent issued in the regular form.

FIG. 1

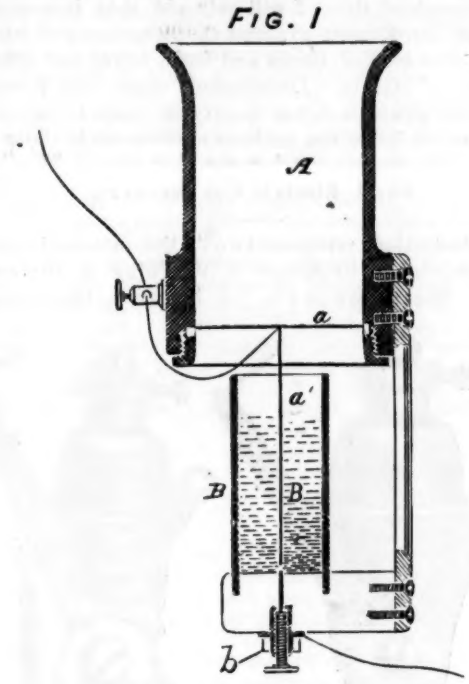


FIG. 1.—GRAY'S CAVEAT.

"When the Pan-Electric people began their raid on the Bell patent, they procured an affidavit from Wilber, sworn to on July 30, 1885, and resworn to in three or four duplicate parts on Aug. 3. In that affidavit he says, in respect to the information he had given Prof. Bell : 'To give such information to applicants for patents had, to an extent, become a custom in the Patent Office; but I now clearly perceive that the law did not contemplate the giving of such information to an applicant for a patent, as it distinctly requires the caveat to be kept secret and the caveator alone to be notified.' This was the whole case with which the Pan-Electric Company began. They had the opinion of Wilber that the practice of the Patent Office then and now was illegal, and they concluded, therefore, that Bell's patent was void.

"At that time Wilber had not discovered that he had shown Gray's caveat to Prof. Bell ; but in the newspapers it was charged that he had done so. On Oct. 7 Wilber wrote a letter to Prof. Bell soliciting an interview, saying : 'There has lately been a great deal of wild, idle and lying talk going around and floating in the newspapers in relation to my grant of the Bell patent. None of it is legitimately based on an affidavit which I have made, and which only recites harmless facts.' Mr. Bell replied, declining to see him.

"Wilber then hunted up Mr. Swan, an attorney of the Bell Company, and proposed to him to make an affidavit contradicting the newspaper stories, which he said were false. Mr. Swan, as I am informed by him, told Wilber that he already had in his possession the criminal court records showing that Wilber had been convicted of various offenses, and meant to use it, but if he wished to make an affidavit he might do so ; and thereupon Wilber went away and wrote out an affidavit, which occupies eight printed pages, giving a full account of the whole transaction, and swearing in respect to this charge that 'in the conduct of such application there was no fraud of any kind whatever, nor anything, any transaction, any communication, oral or written, which would support any such allegation in the least manner whatsoever, either on the part of Prof. Bell, his attorney, myself, or any other person whatsoever.'

"He also swore it was customary to give applicants the dates when the caveats were filed, and offers instances of it from the files of the office. This affidavit was made on Oct. 21 last, and the whole of it is in the handwriting of Wilber. He spent a day in preparing it, and brought it when completed. It is now on file (or should be) in the office of the Attorney-General ; and yet the Pan-Electric people are not ashamed to procure an affidavit from Wiber that he was induced when drunk to sign a paper the contents of which he didn't understand.

"When we presented this affidavit to the Secretary of the Interior, we stated to him that Wilber was an entirely disreputable person, and we presented along with it the criminal court records showing his character and misdemeanors ; so that everybody knew how utterly worthless any statements made by him were.

"While the argument was progressing, however, and after these papers had been read, Wilber, who attended the hearing, came to me while one of the counsel for the petitioners was arguing, and said he had something of importance to say to me. I listened to him, and he then said that the Pan-Electric people had offered him a large sum of money (I think $2,500 was the sum) to make another affidavit for them, but that he preferred to be employed by the Bell Company. He added that I must decide it very quickly, because he was going to take their money if I did not pay him. I waved him away with my hand and turned my back on him, and he left. I at once wrote down what he said, and showed it to Mr. Storrow, my associate, meaning to read it to the Secretary of the Interior when I made my argument ; but upon reflection I concluded that the poor devil was sufficiently disgraced already without adding to it, and I refrained.

"Since then I have heard nothing more from Wilber until the Pan-Electric people produced his affidavit last week, which, if true in every particular, could have no possible effect on the Bell patent, which was sworn to three weeks before the caveat was written, and which affidavit is obviously false, because it was of no importance whatever to Mr. Bell to know what was in the caveat, since it had been overruled by the Commissioner of Patents, and formed no part of the case which he was engaged in prosecuting before the Patent Office, aside from the other consideration that Wilber has sworn already that there is no truth in the statement, and Mr. Bell has testified long ago as to what did happen, when he was a witness in the first case under his patent."

SPECIFICATION.

To all whom it may concern :

Be it known that I, Elisha Gray, of Chicago, in the County of Cook, and State of Illinois, have invented a new art of transmitting vocal sound telegraphically, of which the following is a specification :

It is the object of my invention to transmit the tones of the human voice through a telegraphic circuit, and reproduce them at the receiving end of the line, so that actual conversations can be carried on by persons at long distances apart.

I have invented and patented methods of transmitting musical impressions or sounds telegraphically, and my present invention is based upon a modification of the principle of said invention, which is set forth and described in letters-patent of the United States, granted to me July 27, 1875, respectively numbered 166,095 and 166,096, and also in an application for letters-patent of the United States, filed by me Feb. 23, 1875.

To attain the objects of my invention, I devised an instrument capable of vibrating responsively to all the tones of the human voice, and by which they are rendered audible.

In the accompanying drawings I have shown an apparatus embodying my improvements in the best way now known to me, but I contemplate various other applications, and also changes in the details of construction of the apparatus, some of which would obviously suggest themselves to a skillful electrician, or a person versed in the science of acoustics, on seeing this application.

Fig. 1 represents a vertical central section through the transmitting instrument.

Fig. 2, a similar section through the receiver; and

Fig. 3, a diagram representing the whole apparatus.

My present belief is that the most effective method of providing an apparatus capable of responding to the various tones of the human voice is a tympanum, drum or diaphragm, stretched across one end of the chamber, carrying an apparatus for producing fluctuations in the po-

FIG 2

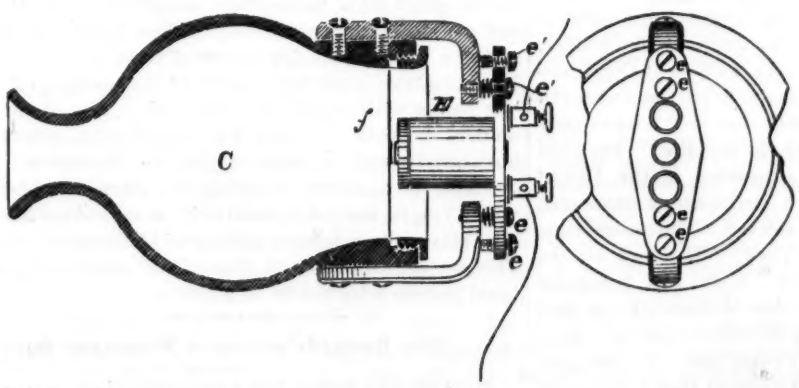


FIG. 2.

Fig 3

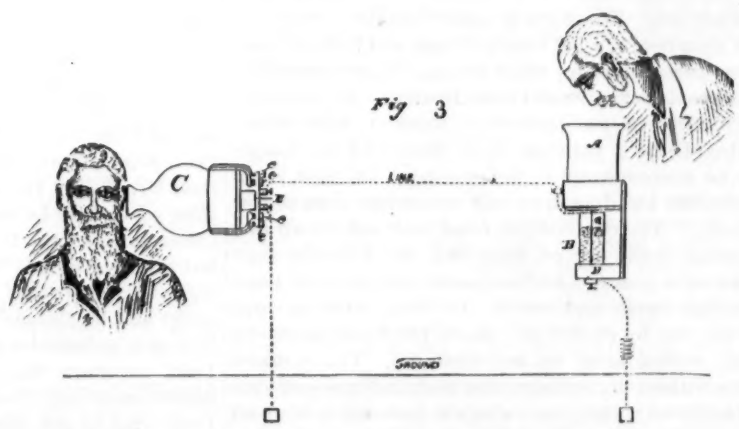


FIG. 3.

GRAY'S CAVEAT OF 1876.

tential of the electric current, and consequently varying in its power.

In the drawings, the person transmitting sounds is shown as talking into a box, or chamber *A*, across the outer end of which is stretched a diaphragm *a*, of some thin substance, such as parchment or gold-beaters skin, capable of responding to all the vibrations of the human voice, whether simple or complex.

Attached to this diaphragm is a light metal rod *A'*, or other suitable conductor of electricity, which extends into a vessel *B*, made of glass or other insulating material, having its lower end closed by a plug, which may be of metal, or through which passes a conductor *b*, forming part of the circuit.

This vessel is filled with some liquid possessing high resistance, such, for instance, as water, so that the vibrations of the plunger or rod *A'*, which does not quite touch the conductor *b*, will cause variations in resistance, and, consequently, in the potential of the current passing through the rod *A'*.

Owing to this construction, the resistance varies constantly in response to the vibrations of the diaphragm, which, although irregular, not only in their amplitude, but in rapidity, are nevertheless transmitted, and can, consequently, be transmitted through a single rod, which could not be done with a positive make and break of the circuit employed, or where contact points are used.

I contemplate, however, the use of a series of diaphragms in a common vocalizing chamber, each diaphragm carrying an independent rod, and responding to a vibration of intensity, in which case contact points mounted on other diaphragms may be employed.

The vibrations thus imparted are transmitted through an electric circuit to the receiving station, in which circuit is included an electro-magnet of ordinary construction, acting upon a diaphragm to which is attached a piece of soft iron, and which diaphragm is stretched across a receiving vocalizing chamber *c*, somewhat similar to the corresponding vocalizing chamber *a*.

The diaphragm at the receiving end of the line is thus thrown into vibration corresponding with those at the transmitting end, and audible sounds or words are produced.

The obvious practical application of my improvement will be to enable persons at a distance to converse with each other through a telegraphic circuit, just as they now do in each other's presence, or through a speaking tube.

I claim as my invention the art of transmitting vocal sounds or conversations telegraphically through an electric circuit.

ELISHA GRAY.

WILLIAM J. PEYTON, } Witnesses.
WM. D. BALDWIN, }

The New York Underground Wire Problem.

One of the best-known men in theatrical and Wall street life, says "Howard," is Theodore Moss, the big-hearted backer of Wallack's Theatre. He is also one of the three commissioners appointed to determine how and when and where telegraph and telephone companies shall lay their underground wires, and, after being pushed and punched about the delay, said: "Between South ferry and Forty-second street there are 314 streets intersected by wires, and there are from 310 wires on a single pole at Rector street and Broadway to one or two on the side streets. There are 7,500 telephones in the city. All these wires have to be put under ground. The messengers' boxes are in a circuit, and they number 15,000. There are 10,000 miles of wire in New York. These comprise telegraph, telephone and electric light wires, and wires for fire and police alarms, for messenger service, electric time service and electric power service. There are as many telephone wires in New York as in nearly all of Great Britain and Ireland combined. The percentage of wires already under ground in this city is greater than in all Great Britain. To show one of the difficulties of the enterprise, there are 6,000 wires crossing Broad street between Wall street and Exchange place, to be systematized in the subway. In New York there are 141,000 building lots. Of these less than 20,000 use electricity. The commission must look out for an immense increase in the use of electrical wires in the next ten and twenty years. At Fourteenth street more than 1,500 wires run north and south. In Green street sewing machines are run by electricity. Room for wires for every conceivable object must be provided for. The demand now for the Edison lights is greater than the inventor can supply. In this city every one wants a messenger box and a telephone. For the successful operation of all these enterprises great power will be necessary."

Telephone Curiosities in the Patent Office.

The Patent Office is the receptacle of curious things sometimes. The other day, says a writer in the New York *Tribune*, my attention was drawn to a petition filed with the Register of Wills by Henry C. Strong, for letters of administration to the estate of one Lancelot H. Everett, supposed to be dead. The petitioner stated that Everett left New Orleans in 1867 to go to England. Since his departure he has not been heard from, and it is supposed he perished in a shipwreck. Everett, it appears, filed certain models in the Patent Office on June 27, 1866. Strong considers himself his heir. He fears, or rather claims, that the models are exposed to view and in danger, and are liable to become the means of depriving the United States of most important evidence in the pending telephone suit against the Bell people. He therefore prays that, in order to preserve and perpetuate the testimony, the models be placed in his custody, subject to the orders of the officers of the United States. I was curious to know what these "most important" models might be and hunted up the specifications under which letters patent had been granted to Lancelot Hope Everett. In his application he states himself what he claims for his invention, I quote the exact language, for nothing else would do Mr. Everett justice:

"Two phonographic locmanauds mounted by acouglottic batteries—names implying machines which generate intelligent sounds, while they communicate to the spiritual sense of hearing through the nervous papillæ of the index finger and thumb tips and through the acoustic trumpet of the external ear, being the natural parts of the body which have direct relationship therewith, so that persons who are deaf and dumb and blind—arising either from physical defects or from length of distances—may hear and hold converse together by means of these locmanauds and copper wires attached thereto."

But enough of this. I will only add that in a separate paragraph Mr. Everett explains that the name of his machine is composed of Greek and Latin words and syllables of words. Certainly, "Locmanaud" casts "Pan-Electric" far into the shade as far as beauty of name is concerned, though as yet it has not made as much noise in the world.

Novel Electric Gas Burners.

Our illustrations represent two of the principal types of gas burners made by Messrs. S. W. Fuller & Holtzer, of Boston. That shown in Fig. 1 is known as the "pendant

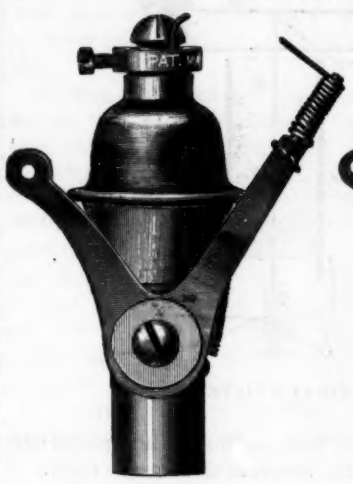


FIG. 1.

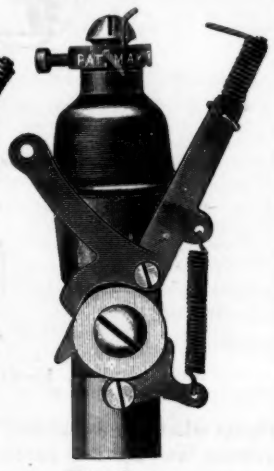


FIG. 2.

burner," and requires the turning on of the gas by hand. The spark formed between the spring electrode and the pin attached to the burner ignites the gas. In the "ratchet burner," Fig. 2, the gas-cock is turned on permanently, and successive pulls upon the pendant chain light and extinguish the gas respectively. The construction of these gas lighters is varied by the substitution of a watch spring in place of the spiral for drawing back the lever to its original position when the pendant is released.

Comment on the Wilber Affidavit.

The subjoined remarks, additional to those we have already given, will be found interesting:

A dispatch of May 22 from Washington says:

Prof. Alex. Graham Bell says that there is not a particle of truth in the story that he paid to Zenas Fisk Wilber, while he (Wilber) was an examiner in the Patent Office, the sum of $100 for information contained in the caveat of Prof. Elisha Gray, etc. Prof. Bell says: "I have only seen Mr. Wilber two or three times in my life. The first time was when he was a patent examiner in the Patent Office at about the time when the Bell patent came out, but after the caveat had all been settled. The second time was about two years ago in New York. We met on the street and he claimed acquaintance. I did not recognize him and he introduced himself as Mr. Wilber. Even then I did not know who he was, and he then said he was a patent examiner when our patent came out. I then said I was glad to see him, but the statement that I ever paid him a cent or offered to pay him anything at any time is not true; neither do I know of any one else paying him anything. I know at the time the Bell patent was issued I would have been glad to have had $100 in my possession.

"I have never seen Mr. Wilber, never had any communication with him and never heard of him until recently in connection with these conflicting affidavits.

"There is not a shadow of foundation for the story. Of course I am not in a position to answer for the rest of the company, but I know that any such accusation applying to any officer of the Bell Telephone Company in Washington is equally false. They must be on their last legs to get up such a story as that."

The Boston *Record*, of May 22, publishes the following: The publication of the affidavit of Zenas Fisk Wilber, which was offered before the telephone investigation committee at Washington yesterday by Mr. Casey Young, has occasioned a flurry of excitement this morning in business circles in this city. Mr. W. H. Forbes, president of the American Bell Telephone Company, was seen by a *Record* reporter at the executive offices of the company on Milk street, this morning. He received the reporter pleasantly, and when he learned the object of his call said: "We are not in the habit here of trying our cases in the newspapers. I am, however, in receipt of dispatches this morning saying that there will be published in to-day's Washington *Post* an interview with Mr. Bell, had last evening, which will constitute a full, clear and emphatic denial of Wilber's statements in regard to Bell; also that the *Post* comments somewhat severely on this phase of the matter, and seems to regard the entire affidavit with suspicion. It simply shows that our opponents are driven to the utmost desperation when they are forced to resort to such moves as bringing forward another affidavit from such a fellow as this man Wilber. He is well known as a thoroughly unreliable drunken man, who has sunk to the lowest depths of infamy to which a man can descend. The fact that the other side have not reserved this affidavit for the courts, but have published it in the newspapers, is but another evidence of the desperation which has seized them; it is evidently for effect upon the Congressional committee before whom this matter is being heard, and upon the general public. This affidavit testifies that he showed Mr. Bell Gray's caveat before Mr. Bell's application was filed. The evidence in the case is that Mr. Bell's application was held here in Boston for 20 days before it was entered at the Patent Office, in order to enable Mr. Bell to learn whether his English application had been made; then it was filed at the Patent Office, and it covered everything that is important in the speaking telephone, just as it is now. The whole story is false, thoroughly false from beginning to end. Wilber has been swearing on all sides of this matter, and it depends on how drunk he is which way he swears. It shows their extremity when they put in any more affidavits from such a man as Wilber, who is already thoroughly discredited before the courts. If you will read his affidavit you will see that he himself testifies that he has been swearing on different sides of this question at different times. Now he declares that his last story is the whole truth. The evidence in the case will show that there is no truth whatever in the substance of what he says. I do not consider that Wilber has injured or prejudiced our case in the slightest. If you, here in Boston, went into the slums and picked out a thoroughly discredited man, it would discredit you or any one who attempted to use such a witness. So it is in this case."

Electric Fountains.

The fountains of the Indian and Colonial Exhibition, in London, are illuminated from underneath by nine large hand-feed arc lamps specially designed and made by the Woodhouse & Rawson Electric Manufacturing Company, Limited. The carbon holders are mounted on insulating blocks attached to saddles, which slide on two base tubes fixed to end brackets, the whole being supported at about an angle of twenty degrees with the horizontal base plate. The feed is effected by a screw passing through the saddles through the tubular guides, one end of which has a right-hand thread, and the other a left-hand thread of double the pitch. This screw is carried through one end-bracket in a tapped bush which is partly split, and can be clamped on the screw by a nut running on an outside taper thread. When this is so clamped, the turning of the screw hand-wheel simply gives the necessary feeding motion, one carbon moving at twice the rate of the other; but if the tapped bush is unclamped and turned on the screw by a hand-wheel attached to it, the screw and carbon holders are bodily shifted longitudinally, thus giving a horizontal adjustment of the position of the arc. To give a universal adjustment of the position of the carbon points with regard to each other, one of the carbon holders consists of a bracket carrying a cylinder fixed horizontally and at right angles to the screw. On this cylinder is a sleeve carrying the carbon holder proper, which can be moved horizontally or turned on it in a vertical plane, thus giving a perfect adjustment of the points. This sleeve is moved and clamped in position by an insulated handle which acts as a screw.

The Rewards of Smart Messenger Boys.

A bright and ruddy-faced messenger boy swung himself on to a Seventh avenue car at Park place a day or two ago, plumped himself in the best corner seat and began to watch proceedings around him with much interest. A *Tribune* reporter questioned him about his work.

"I like it pretty well," he said. "The pay is not big, but the 'overs' are immense. Don't you know what overs are? Why, it's when a man gives you half a dollar and the charge for his message is only twenty-five. Oh, my, that's nothing. I had a man give me a dollar the other day for a thirty-five-cent message. You see, it was to his girl, and he told me particular not to give it to anybody but her, and he told me she was expecting me, and would wear a blue ribbon on her neck, and if anybody came for the message who didn't have a blue ribbon I was not to give it. Say, that was funny, though. When I got up to the girl's house she came to the door. My, but she was a stunner, all silk and lace, but nary blue ribbon. I asked her name, and she said that was her, and I looked right sharp at her neck and said there must be some mistake. She put her hand up to her neck and flushed. Then she said: 'Excuse me a moment,' and away she went. She came back presently with a blue ribbon on, and a quarter in her hand. We make about $5 to $7 a week on the straight. My 'overs' last week were $11. It's only 11 o'clock now, I guess, and I've made ninety cents to-day."

Jamin Magnets.

To the Editor of The Electrical World:

SIR: Will you be kind enough to describe the "Jamin magnet," its form and construction and the kind of steel used? I think an article on the construction of permanent magnets in general would be of interest to many of your subscribers. J. S. M.

HANFORD, Cal.

ANSWER.—We cannot promise to describe what is already embodied in the literature of electricity. Many books describe the construction of permanent magnets, including Jamin's. One of the best on the subject is Sprague's "Electricity."—EDS. E. W.

The Electrical Corn Cure.

To the Editor of The Electrical World:

SIR: Two weeks ago, after a long trial and little success until the time stated, I found a way to remove warts and corns, and without pain, by using an induction apparatus of my own of peculiar form and shape. The electrodes are of the usual kind. One is an ordinary handle, but the other is a long, sharp needle with a little hole pierced near the extreme point. This needle is first dipped in a solution of soda and iodine, then pushed under the wart as near the flesh as possible and the current turned on. Three applications of this kind will entirely remove the wart, which will drop out and leave but a small scar.

DR. J. K. SAMMIS.

Medical Treatment for Electric Light Shocks.

To the Editor of The Electrical World:

SIR: In your issue of May 15 you make mention of sudden deaths by electric light shocks, and suggest that some formula might be laid down for treating a person suffering from an electric shock.

The following may be used while waiting for medical attendance: If the person is unable to swallow give a hypodermic injection of brandy and ammonia and also a solution containing $\frac{1}{60}$ grain of sulphate of atropia; (atropia is very poisonous and great care should be used in administering it).

In the *Medical Record*, Vol. 27, p. 120, Dr. Wm. G. Eggleston gives the history of two cases successfully treated by the use of atropia combined with brandy and ammonia.

NEW YORK CITY. J. W. FLYNN, M. D.

Reducing the Illumination of Incandescent Lamps.

To the Editor of The Electrical World:

SIR: Will you be kind enough to let me know if there is an instrument that is used in electric lighting so that a lamp which is in a bed-room can be reduced in its lighting power. I send a diagram of one. If there is none in existence please let me know? M. J. McG., JR.

HARLEM, N. Y.

ANSWER.—Our correspondent shows a diagram in which a rheostat is interposed in the lamp circuit. This device is not new. Mr. Edison has also devised an arrangement by which a number of carbon rods in a small box attached to the lamp can be thrown in and out of circuit so as to vary the brilliancy of the lamp at will.—EDS. E. W.

The Relative Working Values of Battery Materials.

To the Editor of The Electrical World:

SIR: Dr. Garratt has misconstrued the intended scope of my tables. If he will read again he will see that "the theory is not advanced that a battery material is desirable or undesirable in proportion to its per cent. of available oxygen or chlorine," but is *efficient* in that proportion. My remarks under the head of nitric acid, which has a large percentage of oxygen, show that it is "undesirable," while those in regard to the bichromates of potash and soda, which contain a less per cent. of oxygen, show that I regard them as "very desirable." My intention was, as the title implied, to treat of the "relative *working* values" only, or, as the substance of the article shows, the relative amount of *work* which the various materials are capable of yielding without reference to cost. Any mention of commercial values was purposely omitted, because belonging to a separate factor in the problem of economy. Knowing the working value of any material, and comparing it with its commercial value, its economical value is easily found, as is so clearly explained in your editorial of the 8th, but both of these factors must be known before the answer can be found; hence, one is not more important than the other. If the tables are accurate they will remain permanently useful in all places. It would be quite impossible to make them so if we included in them commercial values, which are constantly changing, and which are not uniform in different countries or in different parts of this country.

It seemed to me to be best to tabulate that which is fixed, and refer to the current price lists for that which fluctuates. I fully agree with Dr. Garratt in regard to the cost of labor in maintaining. It is, indeed, with some batteries a very large factor, but was purposely omitted for reasons similar to those given above. The cost of some of the materials employed in the "chlorine battery" would not permit of their use, were it not for the economy in expense and care of maintaining, which more than over-balances it, and makes it an economical battery.

If, as the doctor intimates, "the atomic weights assigned to some of the elements" are incorrect, he will do the writer a favor by pointing them out and correcting them.

The last paragraph refers to statements made in your editorial, and not to any matter or statement in my article. It, therefore, requires no answer from me.

CAZENOVIA, N. Y. D. H. FITCH.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, May 31, 1886.

The Stout-Meadowcroft Company is moving its offices from 23 Ann street, and will combine them with the factory, corner of Gold and Fulton streets. The change is a good one, saving considerable trouble and expense, and the new location is eminently desirable for offices. The company was the pioneer in introducing electrical effects on the stage here, and has furnished the American Opera Company with some very attractive novelties. Its ingenious devices can be seen sparkling in many theatres nightly.

Pearce & Jones, 79 John street, this city, have issued a very fine catalogue and price list of telegraph and electrical instruments and supplies. It contains no fewer than 120 pages, and is exceedingly comprehensive. One part of it relates to the firm's admirable patent system of police patrol, illustrated not long ago in THE ELECTRICAL WORLD. This system and their fire-alarm apparatus are both highly efficient, and have been cordially indorsed wherever tried.

The Brooklyn Electric Construction Company gave lately an exhibition of its system in the city of Goshen, N. Y., with regular plant and circuit. The display was a brilliant success. Mr. Knowles, the electrician of the company, is doing good work, as is usual with him, and I am not surprised to hear Mr. Kalbfleisch express his high appreciation of it. But the company is coming to the front in another line of distinction. Its base-ball club, organized under the captaincy of Mr. E. Goodrich, played the other day against the Brooklyn Stars and electrified them with a regular arc-light shock. The club won a prize of $10 and a league ball, and now looks around for new foes to conquer—electric light nines preferred.

The American Electric Manufacturing Company loses its pleasant and able Secretary, Mr. W. H. Baker, who is going into another line of business. He is succeeded by a gentleman well known in electric lighting circles, Mr. H. E. Irvine, late Secretary and Treasurer of the Royal Electric Light Company, of Canada. In fact, Mr. Irvine may be looked upon as the founder of arc lighting commercially in the Dominion. Mr. Irvine was also at one time Secretary and Treasurer of the Merchants' Electric Light Company, of Boston. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Mass., May 31. 1886.

The loss by the fire at the factory of the Royal Electric Light Company, at Montreal, was $80,000.

The Wheeler Reflector Company, of Boston, manufacturers of all kinds of reflectors for arc and incandescent lamps, have their extended and enlarged premises fully stocked with a complete line of their attractive and useful goods.

The senior electrical and civil engineers of the Institute of Technology made an excursion on the 26th inst. to Ashburnham, Mass., accompanied by an official of the Boston & Albany Railroad, to examine the electrical signaling apparatus in use there.

The Exeter (N. H.) selectmen are now determined to install an electric light plant in that town at an early day. This will be started up as soon as the contract expires now held by the local gas company, which has exclusive right until the autumn to furnish electric lights in Exeter.

An electric light company is being organized in Nashua, N. H., with Mr. J. H. White as president. The town has already granted permission for the erection of poles and given other privileges, and in addition to a large order for lights received from the authorities, many stores and houses have sent the new enterprise orders for both arc and incandescent lamps.

The Consolidated Electric Light Company, through its New England agency, has just finished the installation of an incandescent plant at the Montague Paper Mills, Turner's Falls, Mass., and the same company is now installing another incandescent plant at the Merrimac Chemical Works, Lowell, Mass.

The New England management of the Sprague Electric Railway and Motor Company reports a steady and growing demand for its machines. Mr. P. A. Dowd, formerly identified with a prominent electrical concern of this city, and Mr. A. T. Starkey, a well-known electrician, are now connected with the New England agency, and their influence and energy will contribute largely to the success of the Sprague Company in this section.

At the State House the telephone controversy is practically at an end, and indications point to another victory for the American Bell Telephone Company. On the 29th instant, in the Senate, the Committee on Mercantile Affairs reported leave to withdraw the petition of G. H. Manning and others defining the right of telephone and telegraph companies to maintain poles and lines of wire in public highways; also another report by same committee, that it is inexpedient to legislate on an order relative to uniform charges for the use of telephones and telephone service by the American Bell and other telephone companies, and relative to placing said companies under control of the railroad commissioners.

Another report of the Committee on Mercantile Affairs is for leave to withdraw, on the petition of George A. Marsden and others, that the American Bell Telephone Company be prohibited from holding more than 30 per cent. of the stock of any sub-company in which it does not now own more than that proportion. From the same committee, leave to withdraw, on the petition of F. W. Stickney and others, that the right of the Bell Telephone Company to hold stock in other telephone companies may be limited.

The plant of incandescent electric lights installed some time ago in the cellars of the Continental Brewery by the Schaefer Electric Light Company, is not only giving satisfaction to the Brewery Company, but is attracting considerable attention and comment from outside parties who are interested in the development and progress of electric lighting. Heretofore it has been considered wellnigh impracticable to install an incandescent plant in the extremely cold and damp cellars of a brewery establishment; but the Schaefer Company has undoubtedly demonstrated the fact that the thing can be accomplished. The lamps in this plant were specially made to withstand the dampness and frigidity of the atmosphere to which they are being subjected, and the wires are incased in rubber. The switching device for turning on or off the lights is located in a convenient spot, some distance from the cellars.

Your correspondent had the pleasure of witnessing, on the 29th inst., a very interesting exhibition of isolated incandescent lighting from primary batteries at the residence of J. H. Howard, Esq., Medford, Mass. The plant consists of nine 8-candle-power lamps, which derive their current from only seventeen cells of "Volta Pavia" solution. The lights are divided into groups as follows: Four in the parlor, two in sitting room, one in lower hallway and two in the dining room. By the aid of an ingeniou switch-board (entirely new in design) invented by Mr. Wm C. Goldner, of Boston, either of the groups of lamps is lighted or extinguished at will. The plant has been in successful operation for nearly three months.

At a lawn party given by the managers of the Country Club, at Clyde Park, Boston, on Thursday, June 3d, the occasion is to be made unusually brilliant by the use of incandescent lamps in the large tent occupied by the merry dancers. Much interest and curiosity has been excited, and even wonder expressed that the managers are able to utilize this, for the city, not uncommon luxury, so far away from any electric lighting station; and it was some little time before it was discovered that the means to be employed is an unostentatious row of primary batteries just outside the tent.

The Country Club are entitled to the honor of first bringing out the fact here that there is such a possibility as portable electric batteries; and the Chemical Electric Light and Power Company, of Boston, will deserve the credit of accomplishing the first installation of the sort in this country by the simple use of primary batteries.

The tent that will be used for dancing is 75 ft. by 50 ft., and it will be brilliantly lighted by 20 16 candle-power incandescent lamps suspended in a very ingenious and artistic manner from frames hung from the tent-pole. The 60-foot-front piazza of the Club House will also be lighted by 10 16-candle lamps, making a very pretty and novel effect. The Volta Pavia cells will be taken to the grounds in teams, the wires run to the lamp circuits and the lights maintained at high candle power for about 6 hours.

Mr. W. W. Burnham, son of Mr. L. W. Burnham, of the Electric Gas-Lighting Company, is now on a trip through New York and Pennsylvania in the interests of the company. He has with him a fine display of the apparatus made by the concern, and will undoubtedly effect large sales as well as gain many friends by his pleasant and gentlemanly bearing. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
PHILADELPHIA, May 31, 1886.

Chief Walker, of the city's Electrical Department, has completed the arrangements for laying the underground cable in Broad street, between Columbia and Lehigh avenues. The distance is about one mile, and for the present the conduit will be used exclusively for electric lighting purposes. In March Councils appropriated $2,500 for laying the conduits and wire, which will be placed along the the east side of Broad street, in the centre of the sidewalk, about ten inches from the surface of the pavement. The wire used will be that of the Standard Underground Cable Company of Pittsburgh. In speaking of the latter Chief Walker says: "I have been experimenting with this cable all winter and spring in the yard of the Electric Light Works in this city. The experiments were virtually in charge of Superintendent Law, of the Brush Company. In making the experiments, we placed sections of the Standard and three other cables underground, and started the current on. I gave them instructions to give all the cables a good test, and burn them up if it were possible. The test continued for three months, day and night; or, in other words, we got six months' work out of them, and when we examined the cables we found that all had been destroyed except the Standard cable. It stood the severest tests known, and we have a guarantee for two years from the company." When the trench is dug a half-inch layer of pitch will be laid in the bottom, and then wooden boxes, two by three inches in the interior in size, will be placed in position. Four cables, two of which are for electric lighting purposes, will be placed in position, with connection at each street corner for lamp poles, and then the lining of the boxes will be covered with roofing pitch. It is the intention at present to erect eight lights, one on each corner north from Columbia avenue, on iron poles twenty-one feet above the level of the pavement. The remaining two cables which will be stretched through the conduit will be held in reserve for telegraph and telephone use at some future date. Chief Walker expects to complete the work very soon, and, when finished, will connect the cables with the wires of either the United States or Thomson-Houston electric light companies, and thus obtain the power for lighting North Broad street.

Recent developments seem to indicate that the underground subject is not to be pressed. City Councils, which have for years been fighting, Quixote-like, this great wind-mill, now appear to be doing all they can to keep the network of wires overhead. A reasonable, general ordinance for the burial of the wires prepared by the Electrical Committee was ready for consideration by Councils a week or more ago, but has been recommitted for some minor amendments of phraseology. The companies can hardly be complained of for not burying their wires when there is no general ordinance enabling them to do so.

Last week the Reading (Pa.) Electric Light and Power Company, by a unanimous vote of its stockholders, increased its capital stock from $100,000 to $150,000.

Mr. Heger, the agent of the Edison Electric Light Company, seems to be doing good work down in Delaware, and along what is known as "the Eastern Shore" of Maryland. He addressed a town meeting at Newark, Del., last week in favor of introducing the light in that place, and obtained nearly enough subscribers to guarantee him an $8,000 plant.

The State Department at Harrisburg issued a charter

last week to the Haverford Electric Light Company, of Philadelphia, with a capital of $5,000.

At the closing session of the "Laryngological Congress" on Saturday there was a very interesting discussion on the efficacy of electricity in the practice of medicine. Dr. Carl Seiler, of this city, spoke of the efficacy of the galvanic cautery in the treatment of hay fever. He said that a great many physicians labored under the impression that hay fever was confined to the nasal cavity alone. This was not strictly correct. The seat of the trouble is sometimes the larynx or the pharynx or the post-nasal cavity. The learned specialist gave the results of his experience in the treatment of this disease, and referred to cases which had been cured by the simple application of the galvanic cautery.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, May 29, 1886.

As mentioned by you last week, the telephone troubles in Indianapolis are quieting down, and the persecution of the Central Union Company by the city officials is relenting. The petition which you also mentioned as being in circulation I have been able to get hold of. The petition is from "Citizens of Indianapolis, some of whom greatly need telephone service in connection with their business," and it says: "We believe it would be a great detriment to the city and its citizens if it is left entirely without telephone service, and that if the city should require the immediate removal of the poles and wires now in use, many persons would be greatly injured and discommoded in their business, and the city would be put to great and useless expense in purchasing and erecting poles upon which to string its fire-alarm telegraph wires now maintained upon the telephone poles. It is evident, also, that after a franchise shall have been granted to a new company, it will take at least three months for such company to erect its poles, string its wires, and establish its exchange in such manner as to afford telephone accommodations to us and the citizens of the city. We therefore respectfully ask your honorable bodies not to require the Central Union Telephone Company to remove its poles and wires from the streets of the city, until such time as a new company shall have been granted a franchise, and shall have erected its poles and established its exchange, and be in a condition to furnish the people with telephone service, and that until such time the Central Union Company be allowed to furnish its patrons service with its present plant in any manner not in violation of the law."

The representatives of the Central Union claim that the company has nothing to do with the circulation of the petition, but state that this will be the only way to bridge over the existing troubles until some relief from the hardships of the present law can be obtained. If the company is not compelled to withdraw from the city it will establish toll-stations at convenient points throughout the city, and will endeavor to operate in this way.

While the worst seems to be over in connection with the telephone troubles in Indianapolis, they have broken out afresh in Evansville. A dispatch from the latter city says: "Some time ago the Cumberland Telephone Company discontinued its night service and began giving very indifferent day service, caused by the refusal of its subscribers to pay more than the legal rate of $3. The city police and fire facilities were badly damaged by this arrangement, and an ordinance was put before the Council repealing the company's right of way through the streets and alleys. The company then offered to restore the service if its subscribers would sign a petition to the Legislature asking the repeal of the law. Very few did this, and the council resolved to take final action. Thus threatened, the company sent word that the night service was renewed, but it was discovered that this only referred to the city telephones, and left citizens as badly off as before. As soon as this was proven beyond a doubt, the council by a unanimous vote passed the ordinance repealing all the telephone company's privileges. What the next move will be is not known, but the company, in order to continue business and use its wires, must furnish full and complete day and night service, charge only the legal rate, and pay the city 3 per cent. of its gross earnings for the use of the city's streets and alleys.

The management of the Cumberland Telephone Company are progressive and liberal. They have always been early in adopting new and improved apparatus, and have never left any means untried for perfecting their system and rendering their service satisfactory to their subscribers. It can confidently be concluded that they are giving Evansville the very best service that the revenue which they derive from that city will admit of, and if the service is falling off, as the dispatch would indicate, it is because it is crippled by the three dollar law.

A little experience will probably teach Evansville what it has taught Indianapolis, namely: that it cannot get along without a first-class telephone service, and that such a service cannot be furnished in return for a compensation of three dollars per month per subscriber.

The Rocky Mountain Bell Telephone Company has issued the following for the information of stockholders:

STATEMENT FOR THREE MONTHS ENDING DEC. 31, 1885.

Gross earnings	$23,101.73
Expenses	16,714.11
Net earnings for the quarter	$6,387.62
Add surplus, Sept. 30, 1885	19,573.98
Total surplus earnings expended in construction to Dec. 31, 1885	$25,961.60
Cost of construction during the quarter	$1,521.17

STATEMENT FOR THREE MONTHS ENDING MARCH 31, 1886.

Gross earnings	$23,185.65
Expenses	15,360.90
Net earnings for the quarter	$7,824.75
Dividend at 1 per cent., paid Jan. 15, 1886	3,910.00
Surplus for the quarter	$3,914.75
Cost of construction during the quarter	525.00

The following toll lines have been built since the last statement.

Butte City to Silver Bow, Montana	6 miles.
Drummond to Phillipsburg, Montana	35 "
Salt Lake City to Bingham, Utah	30 "
Salt Lake City to Sandy, Utah	13 "

Mr. Warren S. Belding, with an office at 182 Dearborn street, Room 34, Chicago, is making a specialty of call-bell and annunciator work.

The following advertisement has appeared in the Chicago papers: "To telephone subscribers—All subscribers and others who favor legislation which shall limit the amount which telephone companies shall be allowed to charge for exchange or ex-territorial service in the State of Illinois, and are ready to co-operate with citizens of other States to secure the passage of such laws in every State, are invited to send their address to Secretary National Telephone League, P. O. box 2,567, Boston, Mass."

The "National Telephone League," in presenting its bill to the Legislature, should label it. "A bill to reduce the efficiency of the telephone service in this State," and thus enable Legislators to see at a glance what the result of passing the bill will be. By the way, I don't believe the above advertisement is receiving many replies from Indianapolis just now. They have tried it down there.

Flint, Michigan, will soon have an electric light plant in operation.

New electric lighting orders received by the Western Electric Company are a twenty-light outfit for the California Jute Works and a forty-light plant for Visali, Cal.

The Sperry Electric Light Company have just received orders for a forty-light arc plant at Carrollton, Mo.; for 20 additional lights to go to Ottawa, Kan., and for 20 additional lights for Grand Island, Neb.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following telephone stock quotations:

Bell of Mo.	$147@$150
Chicago	350@ 360
Central Union	40@ 45
Colorado	18@ 20
Cumberland	65@ 70
Great Southern	25@ 27
Great Southern Scrip, 90 cents on the dollar.	
Iowa Union	15@ 18
Michigan	64@ 66
Mo. & Kan.	53@ 55
Mo. & Kan. Scrip, 53 cents on the dollar.	
Rocky Mountain Bell	40@ 45
United	15@ 17
Wisconsin	107@ 109

W. A. K.

AURORA, Ind., May 29.

Aurora, twenty-five miles west of Cincinnati, witnessed her first electric light display this evening, and the event created a great deal of interest. Over three hundred persons, ladies and gentlemen, visited Samuel Wymond & Co.'s cooperage establishment to witness the starting of an incandescent dynamo. The factory is a large one and lights had been placed throughout. The office, half a block distant, was also supplied with lamps. The dynamo is built under the Silvey patents, and the start was superintended by Mr. Silvey, in person. When the machine was set in operation, the factory was instantly flooded with a beautiful light, all the lights having been turned on at once. The experiment was very successful. The Messrs. Wymond were heartily congratulated for their enterprise in being the first to introduce the electric light in Aurora.

R. C.

SOUTHERN NOTES.

SAVANNAH, Ga., May 13.

The annual meeting of the stockholders of the local Brush Electric Light and Power Company was held in this city last night. Mr. S. P. Hamilton, President and Treasurer, submitted his annual report. The capital stock of the company is $58,000. The earnings last year were $27,660.81. The expenses, including interest on bonds and a considerable outlay for increasing the capacity of the works, were $20,025.69, leaving a net gain of $7,635.12.

A committee of three, consisting of Messrs. L. Kayton, George W. Allen and H. Bendheim, was appointed to nominate a board of directors. The committee retired and after a brief consultation reported the names of the following gentlemen: S. P. Hamilton, D. G. Purse, J. C. Rowland, L. Kayton, Lee Roy Myers, S. S. Guckenheimer, H. A. Crane, C. H. Wilcox, H. Bendheim. The chairman, under instructions, cast the vote of the meeting for the nominations. There being no further business the meeting adjourned. The directors met after the stockholders' meeting and organized as follows: President and Treasurer, S. P. Hamilton; Vice-President, D. G. Purse; Secretary, S. S. Guckenheimer.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., May 15, 1886.

At a meeting this week of the city board, bids were opened in response to the advertisement for proposals to light the streets with electricity or gas during the two years commencing July 1st next as follows. The specifications require that the bidder shall include in his bid the care of the lamps and posts, the repair of street guides and shall light the lamps every night except three in each month—the night of the full moon and the nights preceding and following that event. Each bid must be accompanied by a check for $5,000 payable to the Clerk of the Board:

A proposal was received from the San Francisco Gaslight Company offering to light the streets for 13 cents per lamp per night.

A bid was received from James McMurtrie to light the city with electricity, but as it was unaccompanied by a check it was ordered returned to the bidder unread.

The following proposition was received from the California Electric Light Company:

To erect and maintain in the main part of the city 848 Brush electric lights, of 2,000 candle-power each, on poles, at 66 cents per night each, and 128 Brush electric lights, of 4,000 candle-power, at $1.32, the location of each lamp being shown on a map accompanying the bid. The total annual cost of this system would be $237,536.64. Of the lights, 800 would be on the wide streets and 48 on the narrow streets, the poles to be 12 inches square and 6 inches at the top, properly planed and painted and 35 feet high. The 128 lights of 4,000 candle-power would be on 32-foot masts, four lamps to each mast. Every light is to be covered with a clear flint globe, and the entire system to be in operation on August 1, 1886. As an additional proposition called for by the proposals, the company offered to erect and maintain in the outlying districts of the city, 24 or more masts 150 feet high, having electric lights of 16,000 candle-power, at $5.28 per night; three or more masts 100 feet high, having lights of 16,000 candle-power, at $5.28; one or more masts, 40 feet high, light of 2,000 candle-power, at 66 cents each. The latter of these will be erected in Chinatown, at places to be designated by the Chief of Police. On motion all the bids were referred to the Committee on Street Lights.

THE TELEGRAPH.

T. M. B. A.—Assessment No. 198 of June 1 has been made to meet the death claims of C. W. Ross, F. M. Roberts and W. J. Rideout. The assessment is due from members holding certificates up to 5,373.

The Cheerful Commercial.—The Mackay-Bennett cable people say they are positively taking in more money now at 25 cents a word than they took in before at 40 cents, and they have the guarantee from many old customers to give them their patronage so long as the company agrees not to restore the 40-cent rate.

No Strike Thought of.—Telegraph operators say they are not contemplating a general strike throughout the country. Any grievances they may have are of a local character, and can, they think, be readily settled by arbitration. One of the important steps recently taken by the telegraphers' organization was the decision not to affiliate with the Knights of Labor. A special meeting of operators was called last week here, it is stated, to determine this point. The discussion of the question was altogether one-sided. All the operators present were convinced that they would lose rather than gain by joining the Knights. The last strike of the telegraphers in 1883 was referred to, and it was asserted that, while the Knights had been prodigal in promises of assistance, they had given no practical help. The result of the debate was a unanimous vote against affiliation with the Knights.

A Fatal Fall.—A special dispatch of May 18 from Fort Worth, Tex., says: "R. L. Leiter, a telegraph operator working for the railroad, was walking yesterday on a trestle 400 feet long and 45 feet high, when the mail and express over the Fort Worth & Denver came on and the engineer was unable to stop the train in time to allow the operator to escape. Realizing the situation, Leiter crawled out on the trestle and let himself down, hanging by the stringers. By this time a number of people saw his situation, and the scene was a dramatic one. The train rolled across the trestle about half way, when a shriek was heard and Leiter's body was seen falling through space and then striking the ground below. The shaking of the trestle by the train had loosened his hold and caused him to fall. When picked up he was still alive. One leg was broken, and he had received internal injuries from which he died last night. Leiter was 26 years old and unmarried."

The Two Million Suit.—In the $2,000,000 suit for damages brought by Receiver Farnsworth of the Bankers & Merchants' Telegraph Company, against the Western Union Company, Judge Lawrence decided last week not to accept the testimony of the Pennsylvania witness. The court held that the receivers of the Bankers & Merchants' Company in the several States where they were appointed held the title to the company's property in their States. It is held to be real property and governed by the laws in such cases. Therefore the cause for an action for trespass arose in each State, and must be brought by each receiver. He decided that General Farnsworth, as receiver, could only bring an action for trespass in this State. On the other hand, evidence was admitted, including that of Mr. D. H. Bates, President of the Baltimore & Ohio Telegraph Company, as to the value of the whole "system" that was crippled. The witnesses fixed the value at more than $3,000,000. In consequence of the illness of a juror, the case was adjourned until Tuesday, June 1, when it was resumed.

Damages for Non-Delivery.—A dispatch of May 28 from Detroit says: The suit of J. Jenks & Co., of Sand Beach, against the Western Union Telegraph Company for damages for the non-delivery of a telegram was again brought before the United States Circuit Court in this district yesterday on a motion for a new trial made by the telegraph company. It is alleged that in October, 1884, Jenks & Co., millers at Sand Beach, should have received a telegraphic order dispatched by their Portland (Me.) agent, instructing them to buy 1,000 barrels of flour at $4.25 per barrel for a customer, but the telegram miscarried, and they knew nothing of the matter until January, 1885, when they were called upon to execute the order. This could not be done without great loss, as flour had risen in value, and the suit was to recover the difference in price between what they would have paid in the previous October and what they actually had to pay in January, 1885. The suit was decided in the District Court a year ago in favor of Jenks & Co., and a verdict of $617 awarded them, and the telegraph company's motion for a new trial was heard and submitted to both the Circuit and District judges in the same court. It was claimed that if the message was not delivered the company could not be held for more than 50 times the amount paid for sending it, which was 60 cents. This morning the court rendered its decision, refusing to grant the motion for a new trial, thus re-affirming the law of the case, and holding the last-mentioned claim of the telegraph company not good.

THE TELEPHONE.

Railway Telephone and Signal.—The Consolidated Railway Telephone and Signal Company of Chicago, Ill., has been incorporated by W. Vogel and others with a capital stock of $5,000,000.

A Long Southern Circuit.—The telephone line from Austin to Houston and Galveston, with a total length of 215 miles, is now complete, and conversation is satisfactorily carried on over the whole line with the greatest ease.

THE ELECTRIC LIGHT.

Lowell, Mass.—Between three and four hundred incandescent lights are being put in for general use, and it is said that the arc is likely to be retired from indoor service altogether in favor of the incandescent.

Lighting New York Clubs.—The Union League is preparing to erect a dynamo in its cellar, so that it can supply its own electric lighting in preference to being on a circuit. The League, the Union and the Lotos are illuminated by electric lights.

Elmira, N. Y.—At a special meeting of the Common Council held on May 24, a resolution was introduced to substitute Thomson-Houston lights of 2,000 c. p. for those

of another make now in use. The resolution was adopted with only one dissentient voice.

Monongahela City, Pa.—A company has been formed and has applied for a charter as the Monongahela City Electric Light Company. It proposes to furnish subscribers with incandescent lights at $1 per month each. About 250 lamps have been subscribed for. No decision has been reached as to what system will be used, but the Mather-Perkins is the most favorably mentioned. Wm. McGregor is the Secretary.

Tower Lighting.—The Star Iron Tower Company, of Fort Wayne, Ind., has just closed a contract with the Jacksonville, Ill., Gas Company to erect six Star iron towers in that city, on which Thomson-Houston lights will be used. Also a contract for the erection of one tower at Kansas City, Mo., for Fort Wayne Jenney lights, at the new panorama of the battle of Missionary Ridge which is being put in at that place.

A New Arc Lamp.—There has recently been put in operation in this city an arc lamp, designed by Dr. E. C. Ohmart, which bids fair to occupy a prominent position in the future. Its main feature consists in the arrangements by which, it is said, the carbons are enabled to last for one hundred hours and over, so that the lamp requires no attention for days at a time. Pending the issuance of patents, the inventor refrains from entering more fully into the details of this interesting lamp.

Search Lights for Swift Ocean Steamers.—Lord Alfred S. Churchill, writing to English papers, with regard to the loss of the "Oregon," says: "The fact is that these great American liners travel at such a speed—viz., from 16 to 20 miles an hour—that on a dark night they come upon a strange vessel so rapidly that neither of them has much chance of avoiding a collision if not seen at some distance off. My proposal is that these fast steamers should be fitted with electric search lights similar to those now in use on war ships, and that through the whole night these should be kept at work sweeping the horizon in front of and on either bow of the ship."

Finding Buried Miners.—In its Paris letter, *Science* for May 7 mentions a very ingenious and valuable device by which some workmen buried in a mine near Périgueux, in the south of France, were sought. After these workmen had been buried by an avalanche of rocks and earth, MM. Siemens and Langlois, the engineer and photographer, finding that all attempts to communicate with them proved ineffectual, had a hole bored down directly into the cave, large enough to admit of passing provisions and tools, and they sent down into the hole an electric lamp strong enough to illuminate the whole cave, and after that a photographic apparatus. The plate, after some time of exposure in the cave, came up so perfectly impressed that it revealed the exact state of things. True, the scene was ghastly indeed, and dead bodies only were pictured by it, but the experiment proved that this plan may hereafter be resorted to with success in mine accidents.

Salem, Mass.—Salem has asked the Brush-Swan Company for its figures for running 90 to 100 arc lights. This is done, says the *Manufacturers' Gazette*, under the spur of a motion to invest $30,000 in a city electric plant. One company estimated for two steel 125 horse-power boilers, 260 horse-power engines, stack heater, pump, injector, etc., for $7,750, and another, the Brush-Swan, two double set of thirty lights each of 2,000 candle-power lights, twenty miles of wire and seventy lights, all complete on poles, for $16,705, not to be paid for until sixty days of practical and satisfactory trial. The cost of a brick building, 100 × 75 feet, to hold this plant, would be about $3,000. It is estimated that they would run ten hours in summer and fifteen in winter; two engineers at $2.50 a day, and coal $3.60, wear and tear $1.50 a light. These were the inducements to make it cheap for the city to own and run the works.

Incandescent Lamps Filled with Hydrogen.—The *Elektrotech. Zeitschrift* of April, 1886, says that lately the Bros. Siemens have been manufacturing glow lamps, whose glasses are filled with hydrogen. It had been remarked before that glow lamps in which the inner glass wall had been rendered brown could be cleaned by filling them with hydrogen and then exposing both the carbon filament and glass to a high temperature. These lamps are said never to become brown at all, and to last longer. They can be used with higher electromotive forces, and consequently under conditions considerably more favorable to economy, without diminishing their wear. It is thought that many evils which are found in the vacuous glow lamps now in use will disappear when the carbon filament is in an atmosphere of a gas exerting considerable pressure, but not acting chemically upon it.

A Magnificent Lake Steamer.—The new steamer "City of Cleveland," said to be the finest craft afloat on the Lakes, is now running between Cleveland and Detroit. She beat the record on her first trip, on May 26th. She is lighted from stem to stern with incandescent lights. As was appropriate, the entire plant for this electric lighting has been furnished by the Brush Electric Company, of Cleveland. The plant consists of two of the new pattern, self-regulating dynamos, one having a capacity of 300 lights, and the other of 150 lights. Two Armington & Sims engines, specially built for low steam pressure, form a part of the plant. The steamer is wired with several independent circuits, and a fine system of switches enables the engineer to control any of the lights from the dynamo room. The steamer is very brilliantly lighted, as may be imagined from the size of the plant. Swan lamps of standard sixteen candle-power are used, and each stateroom is furnished with an etched lamp, giving a soft, mellow light. The main saloon has four magnificent chandeliers, each carrying nineteen electric lamps. All the passage ways and spaces usually dark are brilliantly illuminated. The clean, safe and beautiful electric light, as furnished by the Brush Electric Company, will doubtless be thoroughly appreciated by the traveling public. The electric plant is one of the finest that has ever been installed.

APPLICATIONS OF POWER.

Woonsocket, R. I.—The Woonsocket Electric Light Company stands ready to furnish from one to fifty horse-power to parties in any place in the village.

Detroit, Mich.—The Detroit Electric Railway Company has been granted the right of way to build a railroad from the western limits of the city to Toledo avenue, and along that avenue to either Waterman or Fort street.

The Bessbrook Tramway.—For some months an electric tramway between Newry and Bessbrook, Ireland, has been operated experimentally, and it has now been accepted from the contractors by the company as satisfactory. Some 10,000 miles have already been run and 43,000 passengers carried. The line is about three miles long.

PERSONALS.

Mr. Jerome Carty, of Philadelphia, is now in London, representing the United States government there for the purpose of obtaining evidence in the suit to annul the Bell patent.

Mr. Mark W. Samuel has resigned his position as Manager and Treasurer of the National Printing Telegraph Company, and left for Europe on the steamer "Arizona," June 1, on a combined business and pleasure trip.

Mr. Francis W. Jones, the general manager of the United Lines, created a very favorable impression last week in electrical circles by the clear, thorough and careful manner in which he gave his evidence in the suit against the Western Union Company for $2,000,000, damages. A man needs to be an expert and something more to undergo direct and cross-examination for two days and a half at the hands of such counsel as Conkling, Ingersoll and Choate, and then to leave the stand cool as a cucumber and without having made a single slip of any kind.

Honors for an Electrician.—In recognition of the great advance exhibited in Mr. Lucius J. Phelps' method of communicating telegraphically with moving trains the Franklin Institue has awarded to that gentleman the John Scott Medal and Prize. Some time since a special committee appointed for the purpose examined the system fully as it is operated on the New York and New Haven Railroad, and upon their recommendation the award was made. Mr. Phelps' system was fully described in THE ELECTRICAL WORLD of Feb. 21, 1885. Since then Mr. Phelps has introduced numerous improvements by which he duplexes his line, thus adding greatly to its capacity.

Editor Rosewater.—A Washington letter to the Cleveland *Leader* says: "I chatted the other day with Editor Rosewater, of the Omaha *Bee*, about his career as telegrapher in the War Department under Lincoln. Said Mr. Rosewater: 'I sent out the first official dispatch of the Emancipation Proclamation. It was sent out on the evening of Jan. 1, 1863. I attended the President's New Year reception that day, and though this move was expected by the people it excited no comment. The colored people about Washington made no celebration whatever, and no one appreciated the magnitude of the act. The picture of Lincoln signing this proclamation, which hangs in the Capitol, and which cost $25,000, is all bosh. There was no such scene as is there represented.'"

Mr. McLane, U. S. Minister, arrived from France on the 31st ult. He says: "The day I left Paris, May 21, the cable conference was settled and I signed the protocol. It substantially conceded what the companies demanded, namely, subjecting all damages that might be inflicted and all criminal offenses that might be incurred to the judgment of the common law. A special provision of the convention agreed that the whole subject should be left to the tribunals of the different countries as far as England and America are concerned, that is, of course, to the common law. That's what the Western Union and Commercial Cable Companies wanted," continued the Minister. "They were both allowed to take part in the committee of the conference, and their views were carefully considered, I can assure you. They did not get all they wanted. Who does in this world? I was instructed by my Government to support the cable companies, and did it. I acted under the State Department's instructions. We had two full conferences and five or six committee meetings. The result was substantially in harmony also with the wishes of the English companies."

MISCELLANEOUS NOTES.

A Strike Ended.—The strike at the Edison Works has come to an end, and the 220 men who went out are now back at work.

Electrical Appliances.—The Parish Brothers and Peck Electrical Company of Detroit, Mich., is announced, with a capital stock of $1,000,000. Mr. H. B. Peck is one of the incorporators.

Introducing Telegraph Fire Alarms.—Hoboken, N. J., is soon, it is said, to have a telegraph fire alarm. A dispatch from Norwalk, Conn., of May 22 says also, regarding that place: The growth of this town in population from about three thousand forty years ago to over sixteen thousand at this time, and the maintenance now of a first-class fire department inspires the people who pay taxes to provide modern appliances for giving prompt notice of fires. Hitherto certain strokes on the fire bell perched in a central place on a frame of timber has been the only means of notification, and often the delay in ringing the bell has resulted in the loss of property. At a borough meeting a resolution authorizing an appropriation of $2,000 to introduce a telegraph fire alarm system similar to that in New York City was carried with only one dissenting voice.

The Broadway Arcade Road.—Property owners along the line oppose the plan of the Arcade Company. The bill recently passed allows the Arcade Company to take forty-four feet under the street in Broadway for the purposes of its railway. Double tracks of standard gauge are to be laid and entrances to depots are to be opened on side streets. The first section of the road between the Battery and Forty-second street is required to be completed within five years. The pipes, mains, wires, etc., are to be placed in a huge conduit provided by the railroad company, to be delivered over to the city free of charge. Three commissioners are to be appointed by the Governor to superintend the work of construction, and no work is to be done until these commissioners certify that the company has made proper financial arrangements to complete the road. Double time is to be allowed for time lost by reason of legal proceedings.

SPARKS AND FLASHES.

A Heartless Inventor.—Mr. Hussey, of Menlo Park, has invented an electrical clock that runs without winding. The man who generally becomes thirsty about midnight, and invents an excuse to go down stairs by saying that he forgot to wind the clock, will not give a cordial welcome to the new timepiece.—*Norristown Herald.*

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—B. & M., b 2, a 3; Western Union, b 62¼, a 62¾.

Telephone.—Am. Bell, b 172¼, a 173; Erie, b 28, a 28¼.

Electric Light.—No new quotations.

BUSINESS NOTICES.

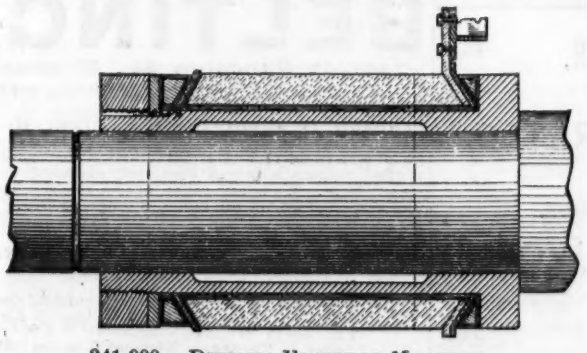
Dean's Rheumatic Pills

Are a sure cure, a superior remedy, almost infallible; 50c.
HALE'S HONEY, the great cough cure, 25c., 50c. and $1.
GLENN'S SULPHUR SOAP heals and beautifies the skin; 25c.
GERMAN CORN REMOVER kills corns and bunions; 25c.
HILL'S HAIR AND WHISKER DYE, black and brown, 50c.
PIKE'S TOOTHACHE DROPS will cure in one minute; 25c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 18, 1886.

341,873. Laryngoscope; Havens B. Bayles, Brooklyn, N. Y. Consists of a suitable mirror and incandescent



341,990. DYNAMO-ELECTRIC MACHINE.

electric light, placed at an angle to the length of the instrument, whereby the direct rays of light are used for illumination.

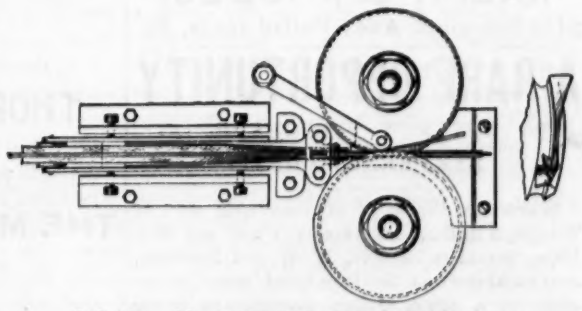
341,882. Gas Lighter; Asa F. Cogswell, William Young and John R. Alderman, Kansas City, Mo. Consists of an electro-magnet and suitable electrical conducting-wires connected with the electro-magnet and arranged to create a spark of electricity when the circuit is completed. There is a stop-cock on said apparatus and a crown-wheel in said stop-cock, a slotted polarized armature in the field of the electro-magnet and operated thereby, and a spring lever in the slot in engaging relations with the crown-wheel.

341,907. Galvanic Battery; Alonzo C. Harris, Louisville, Ky. Consists of battery-cells in the drawer of the apparatus adapted to register with the cells in one position of the drawer or drawers, and adapted to stand beside the cells when the drawer is in another position.

341,909. Annunciator and Fire Alarm; Albert T. Hess, Des Moines, Iowa. Consists of an electric bell and double-contact circuit-closer in a room, and an annunciator and double-contact circuit-closer in an office or central station, with two distinct batteries, so that there will be no electric current through the annunciator-coils in making a return signal from the office to the room.

341,918. Indicator for Circuits; Oscar T. Jönsson, Stockholm, Sweden. Consists of details in the usual combination of solenoids and operating levers.

341,926. Gas Electric Advertiser Cock; Leon Lenaerts and Henri L'Olivier, Brussels, Belgium. The leading claim is an alarm system for giving notice of the position of the key of a gas-burner, consisting in the combination with such burner, a meter and the



342,085. MACHINE FOR COVERING WIRE.

connecting-pipe, of cocks for cutting off the gas at the meter and burner, respectively, an electric circuit, and movable contacts in said circuit at the meter

and burner, respectively, for making and breaking said circuit.

341,981. Armature; Orosco C. Woolson, Newark, N. J., Assignor to Charles A. Cheever, Trustee, New York, N. Y. It is a sliding solenoid core provided with magnetic portions that bind when acted upon. See cut.

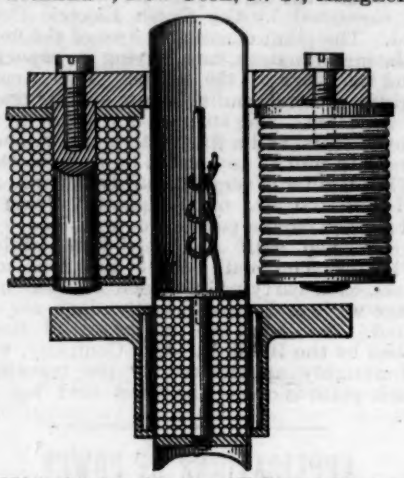
341,990. Dynamo; Charles Bachelor, New York, N. Y. Relates to the commutator shown in the cut. The conducting bars are insulated from a cylinder located upon the shaft.

341,997. Incandescent Lamp; Louis J. Crossley and James J. Hicks, London, England. The bulb is blown from a tube composed of alternate strips of differently colored glass.

342,013. Watchman's Electric Time-Recorder; Charles W. Holtzer, Brookline, Mass. One claim is: In an electric recording attachment for clocks, the combination of a rotatable dial face plate, perforators thereto, and a stop for said perforators, facing said face plate, concentric to the centre of rotation of said face plate and opposite said perforators. The other claims are for further improvements.

342,018. Electric Valve; Warren G. Johnson, Whitewater, Assignor to the Johnson Electric Service Co., Milwaukee, Wis. Consists of details in the usual combination of magnets, thermostat and operating levers.

342,085. Machine for Covering Electrical Wires; William D. Grimshaw, New York, N. Y., Assignor to John



341,981. ARMATURE FOR ELECTRO-MAGNETS.

L. Arts, Troy, N. Y. The novel features are shown in the cut in combination.

342,086. Pendulum Clock; Friedrich and Otto Haerichen, Philadelphia, Pa., Assignors to themselves and Oscar Seebass, New York, N. Y. Relates to an improvement upon their patent 316,360, of April 21, 1885.

342,114. Thermostatic Circuit Controlling Device Morris Martin, Malden, Mass. A T-shaped circuit closer is provided and is responsive to the action of the thermostat

342,246. Driving Mechanism for Suspended Cars; John A. Enos, Peabody, Mass. Consists in a supporting-truck having wheels which rest upon a single rail, combined with an electric motor, the revolving armature of which is rigidly fixed upon the same shaft as the wheels of the suspending-truck.

342,280. Conduit; John R. Burdick, Chicago, Ill. Consists of a multitubular conduit formed in sections, having a central passage enlarged or recessed at one end, in combination with a tie-rod, also made in sections, united by a shoulder screw-joint within the recessed ends of the conduit-sections.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, 9 Murray st., New York.

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Will supply and take care of ten to twelve 16 c. p. Incandescent Lamps at any point on an Arc Light circuit from an initial current of 9.5 ampères, equal to 2,000 c. p. Arc Lamp.

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Any Number of the Lamps Can be Turned On or Off Without Affecting the Rest.

Invaluable to **Arc Lighting Companies** as a means by which they **can secure customers, from one up, for incandescent lighting anywhere on their circuit** without involving large expense for incandescent lighting plants, or the necessity of getting a large number of subscribers to commence with, and also valuable to incandescent lighting companies for customers too distant for the ordinary incandescent circuits. Address

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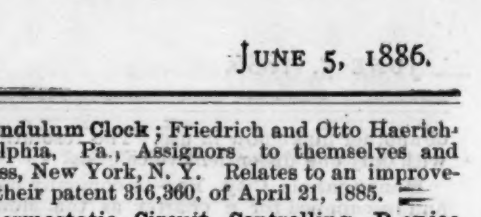

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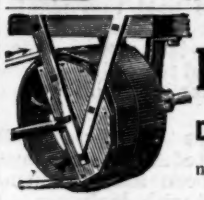

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